

## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE:

- 2 JUL 1980

SUBJECT:

Evaluation of 308 Response from duPont, East Chicago, Indiana

FROM:

*Richard A. Shandross*  
Richard A. Shandross  
Environmental Engineer*David Homer*  
David Homer  
Physical Scientist

TO:

Jerry Frum, Attorney  
Enforcement Division

US EPA RECORDS CENTER REGION 5



508909

THRU:

Jay S. Goldstein, Chief *Kathleen Hammer, acting for*  
Hazardous Waste Management Section

In response to your telephone request of several weeks ago to evaluate duPont's 308 letter response, we have prepared the following report. We apologize for the length of time it has taken to reply; the promulgation of the new RCRA regulations has kept us quite busy.

In summary, the following are our recommendations for proceeding with the investigation, in order of priority:


- 1) Investigate the migration or potential migration of the nine substances present which are listed in table 117.3 of 40 CFR 117. (297 Hazardous Substances under the Clean Water Act.)
- 2) Consider covering areas of the site to prevent hazardous dusts, mists, fumes, etc., from becoming airborne, if any are present. Groundwater monitoring and/or treatment may be necessary.
- 3) Request more detailed information on various processes and the materials used in these processes during times of disposal.

These recommendations are discussed in detail below. Basically, we find the 308 response to be thorough, and indicative of an interest on the part of the company to work with us on this situation.


1) 311 CWA - Hazardous Substance Disposal.

- a) Vanadium pentoxide (1955-1974). Area 4. Amount unknown.
- b) Antimony pentachloride (1941-1974). Area 5. Estimate of 68.4 tons.  
Note: reactive with water
- c) Calcium arsenate (1910-1949). Area 8. Amount unknown.
- d) Lead arsenate (1910-1949). Area 8. Amount unknown.

- e) Arsenic trioxide (1910-1949). Area 8. Amount unknown.
- f) Dichlorobenzene/chlorobenzene (1974-present). Area 9.  
Estimate of 0.5 ton. By-product of degradation of linuron.
- g) Anmonium sulfamate (1974-present). Area 9. Amount unknown.  
Probable contaminant of cake filter disposed.
- h) Sodium hydroxide (1974-1977). Area 9. Estimate of 125 tons.  
Reported as aqueous  $\text{Na}_2\text{O}$  in "hardtac/precoat" sludge. (Also in same way as contaminant of filter aid in Areas 4 and 6. Amount unknown.)
- i) Calcium hydroxide (1974-present). Areas 9 and 10. Estimate of 2060 tons total. Present in "hardtac/precoat" and Freon sludges.

See figure 1 for a map of the locations of these areas. Note that the Grand Calumet River is to the south and southwest of the heavily outlined disposal areas. Surface run-off from these areas to the river is probably unlikely due to the presence of buildings. 

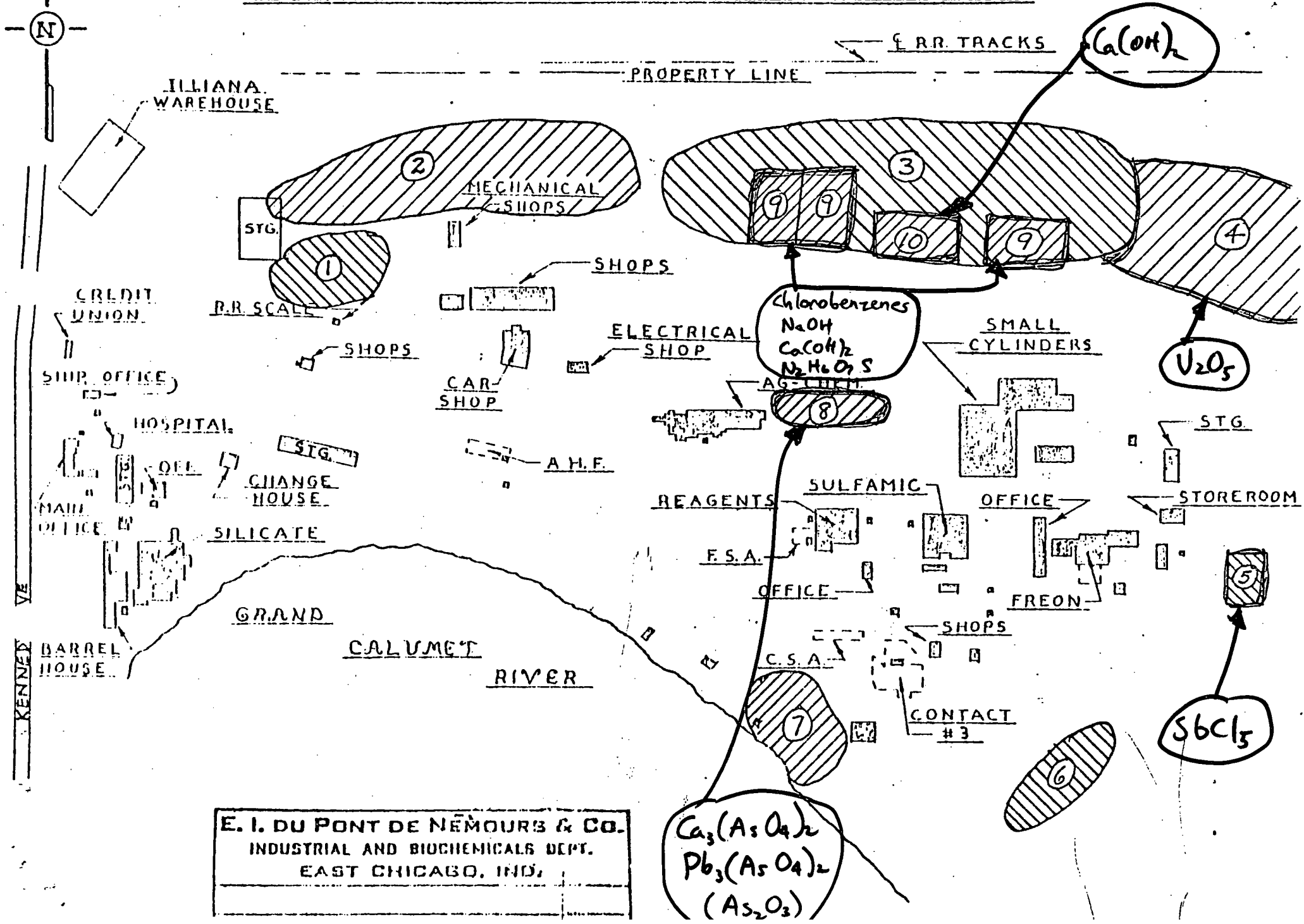
There exists the possibility of transportation of the contaminants to the river by groundwater. Some factors involved in this are: the depth to groundwater, soil types and hydrologic properties, soil attenuation characteristics for each contaminant, distance from the river, recharge rates, and time since disposal. Depth to groundwater is probably 1-10 feet in the area, and soil type is sand, silt and gravel. Distances, as can be calculated from figure 1, are from 800' to 1800'. Other parameters are not known or take further research to determine.

Taking and analyzing the proper samples to determine the actual migration of materials would be a more productive endeavor than calculating this based on known information. As previously discussed, we might find the company willing to do the proper investigative work, and should request that they do so. 

The contaminants may have already been flushed from the site, or still be in the groundwater anywhere between the disposal area and the river. Sampling should be done at various distances from the disposal areas in the direction of the Grand Calumet.

Undoubtedly, there is a possibility that the disposal has contaminated groundwater in other directions. A discussion of groundwater aspects follows in the next section.

# DuPont - East Chicago Plant



## 2) Air Emissions/ Groundwater Monitoring.

Twelve of the substances disposed of at the site have OSHA limits on their air concentrations in workplaces, which implies that they are dangerous to inhale. See the attachments for descriptions of the hazards. The limits taken from 29 CFR 1910.1000 are:

Ammonium sulfamate	15 mg/M <sup>3</sup>	(8-hours time weighted average)
Antimony pentachloride (as Sb)	0.5 mg/M <sup>3</sup>	(8-hTWA)
Hydrochloric acid	7 mg/M <sup>3</sup>	(Ceiling value)
Calcium arsenate	1 mg/M <sup>3</sup>	(8-hTWA)
Lead arsenate	15 mg/M <sup>3</sup>	(8-hTWA)
Arsenic trioxide* (as As)	0.5 mg/M <sup>3</sup>	(8-hTWA)
Calcium fluoride (as F)	2.5 mg/M <sup>3</sup>	(8-hTWA)
Chlorobenzene	350 mg/M <sup>3</sup>	(8-hTWA)
Sodium hydroxide	2 mg/M <sup>3</sup>	(8-hTWA)
Silica	various formulae depending on form	(8-hTWA)
Vanadium pentoxide	0.5 mg/M <sup>3</sup> dust	(8-hTWA)
	0.1 mg/M <sup>3</sup> fume	
Zinc Oxide	5 mg/M <sup>3</sup>	(8-hTWA)

\* Commercial lead arsenate contained from 31% - 33%  $As_2O_3$ . The 308 reply did not specify whether the arsenate disposal was by-product or off-spec material. By-product could contain nitric and acetic acid. Both are on the CWA-Hazardous Substance List; their 8-hTWA's are 25 mg/M<sup>3</sup> and .5 mg/M<sup>3</sup> respectively. They should perhaps thus also be included in the list in the first section ('311' Substances). See the attachments for toxicologic and hazard data.

In addition, calcium hydroxide is considered an air contaminant as a dust, and calcium sulfate and sulfur have toxic and/or reactive fumes upon heating.

② The dangers posed by the disposal of these materials at duPont are unknown and should be investigated. If necessary, a protective layer of earth, clay, or asphalt should be placed on the areas where these compounds were disposed. Should the land be sold in the future, the deed should contain a notice of the compounds and areas of emplacement, so that any planned earthmoving can take place safely.

Pollution is also possible via groundwater contamination. Discharge of this contaminated water into the Grand Calumet River\* is covered in the first section. The attachments to this report are excerpts from "Dangerous Properties of Industrial Materials" by Saxe, and the Coast Guard's "CHRIS Manual". They describe the toxicological, hazardous, pollution, chemical and physical properties of those compounds listed; there is also firefighting information included, and miscellaneous relevant information.

Nearly every compound listed has warnings for water pollution and ingestion toxicity. Some of the compounds, particularly antimony pentachloride, calcium arsenate, lead arsenate, arsenic trioxide, calcium hydroxide, chlorobenzene, sodium hydroxide and vanadium pentoxide are dangerous in water to humans and/or aquatic life.

Contamination could exist in all directions from the disposal sites, but most probably exists in the direction of the Grand Calumet River. A general plan for a groundwater study would be to:

- a) Determine groundwater flow directions. This data can be used to indicate the probable extent of contamination in any direction.
- b) Based on the outcome of (a) above, wells should be placed to determine, by water sample analysis, the horizontal and vertical bounds of migration of contaminants.
- c) Regardless of the outcome of (a) above, thorough investigation of the extent of contamination in the direction of the river is necessary, due to the '311' possibility.

\* Note that the site is also 2 1/3 miles from Lake Michigan.

As a goal of any further investigation, actions necessary by duPont/EPA should become clear. These actions might include excavation and replacement of soil and/or on-site groundwater treatment (or removal and proper disposal of contaminated groundwater.)

3. Further information needed from duPont.

③ The company is to be commended for its efforts in determining what wastes have been disposed of at the facility. It may be possible, though, to estimate amounts of some wastes disposed, and to determine what compounds may exist in the wastes in some areas. This could be done by examination of records which show process descriptions, raw materials used, and quantities of products produced. One of the difficulties during our review of the 308 response was the lack of specificity of these parameters.

The above-mentioned information should be requested concerning the following production processes:

- Zinc chloride
- Aluminum chloride
- Ammonium chloride
- Those processes whose tank and process cleaning sludges were disposed of in Area 4.
- Calcium arsenate
- " Annate"
- Benomyl
- Siduron

This information, if included in the 308 response, may have caused us to list different compounds in the first and second sections of this report ("311" and Air/Groundwater). Until such information leads us to believe otherwise, we still recommend investigation of those substances listed.

③ In addition, some other information the company may have or be able to get is:

1. Analysis of or information on the arsenic, vanadium, uranium, and uranium decay product concentrations in the phosphate rock used for trisodium phosphate production.

2. What "miscellaneous chemicals" may have been disposed of in Area 4.
3. What chemical(s) was (were) used to neutralize by-product hydrochloric acid, and what other chemicals, if any, this acid contained (Area 5).

cc: Klepitsch  
Kee  
Constantelos  
Bryson  
Muno

Appendices and attachments

## APPENDICES AND ATTACHMENTS

### APPENDICES

1. Description of waste disposal areas.
2. Waste disposal areas other than those shown in figure 1.
  - a. Area 1
  - b. Area 2
  - c. Area 3
  - d. Area 6
  - e. Area 7

### ATTACHMENTS

Saxe and CHRIS excerpts for disposed compounds listed therein:

Ammonium sulfate  
Antimony pentachloride and hydrochloric acid  
Calcium arsenate, lead arsenate and arsenic trioxide  
Calcium fluoride  
Calcium hydroxide  
Calcium sulfate  
Chlorobenzene  
Sodium hydroxide  
Sodium silicate and silica gel  
Sulfur  
Vanadium pentoxide  
Zinc oxide



EAST CHICAGO INACTIVE LAND DISPOSAL SITES

ATTACHMENT B

<u>Area Number</u>	<u>Location</u>	<u>General Description of Facility</u>	<u>Disposal Dates</u>	<u>General Description of Waste</u>	<u>Facility Construction</u>	<u>Site &amp; Ground Water Conditions</u>
1	See map	Waste pile	1909-1969	✓ Waste from manufacture of zinc, aluminum and ammonium chlorides	Waste pile, ~300' x 300'	Unknown
2	See map	Waste pile	Thru 1955	Chain grate stoker ash from old powerhouse	Waste pile, ~1,000' x 400'	Unknown
3	See map	Waste pile	1926-1951	✓ Calcium sulfate from trisodium phosphate operation	Waste pile, ~1,000' x 400'	Unknown
4	See map	General dump area	1955-1974	✓ Misc. chemicals, including sulfur and filter aid	Waste pile, ~1,000' x 1,000'	Unknown
5	See map	Neutralizing pit	1941-1974	✓ HCl from Freon® operations	~200' x 200' unlined pit containing limestone	Unknown
6	See map	Waste pile	1947-1967	Zinc sinters from roasters, sulfur, and sulfur filter aid	Waste pile, ~400' x 500'	Unknown
7	See map	Waste pile	Thru 1969	Fly ash from old powerhouse	Waste pile ~400' x 200'	Unknown
8	See map	Waste pile	1910-1949	✓ Lead arsenate and calcium arsenate wastes	Waste pile, ~400' x 200'	Unknown
10	See map	Waste landfill	1974-1977	Calcium Fluoride	Clay-lined landfill ~200' x 250'	Unknown

ILLIANA  
WAREHOUSE

PROPERTY LINE

4 R.R. TRACKS

MECHANICAL  
LESSHOPS

## SHOPS

ELECTRICAL  
SHOP

SMALL  
-CYLINDERS

AG-CHEM

STG.

- STORE ROOM

OFFICE

FREON

## - SHOPS

CONTACT  
— # 3

## REAGENTS

SULFAMIC

F. S. A.

OFFICE

C.S.A.:-

CAL VME T

RIVER

**E. I. DU PONT DE NEMOURS & CO.**  
INDUSTRIAL AND BIOCHEMICALS DEPT.  
EAST CHICAGO, IND.

$\left\{ \begin{array}{l} \text{ZnCl}_2 \\ \text{AlCl}_3 \end{array} \right\}$  waste mud

ILLIANA  
WAREHOUSE

**PROPERTY LINE**

4 R.R. TRACKS

MECHANICAL  
SHOPS

## SHOPS

ELECTRICAL  
SHOP

SMALL  
-CYLINDERS

-AG-CHEM

## REAGENTS

SULFAMIC

OFFICE

STORE ROOM

FREON

SHOPS

CONTACT  
# 3

RIVER

**E. I. DU PONT DE NEMOURS & Co.**  
INDUSTRIAL AND BIOCHEMICALS DEPT.  
EAST CHICAGO, IND.

1892-1950.

Chain-grate stoker ash

# DUPONT - EAST CHICAGO PLANT

N

ILLIANA  
WAREHOUSE

PROPERTY LINE

RR TRACKS

MECHANICAL  
SHOPS

STG.

1

CREDIT  
UNION

P.R. SCALE

SHOPS

SHOPS

ELECTRICAL  
SHOP

CAR  
SHOP

AG-CHEM

SULFAMIC

SMALL  
CYLINDERS

STG.

STOREROOM

OFFICE

REAGENTS

F.S.A.

OFFICE

FREON

SHOPS

C.S.A.

CONTACT  
#3

HOSPITAL

CHANGE  
HOUSE

SILICATE

GRAND

CALUMET

RIVER

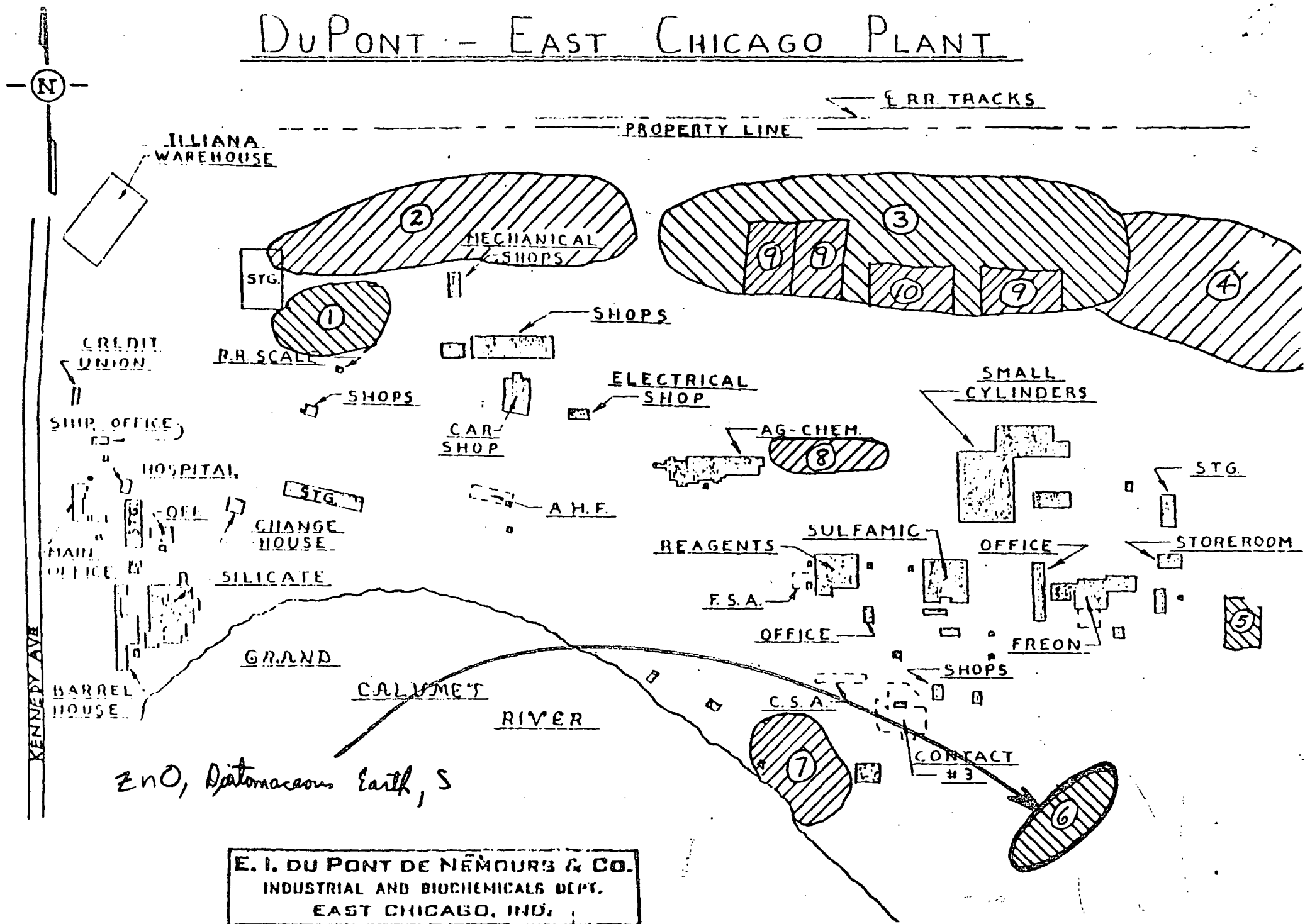
BARREL  
HOUSE

$\text{Na}_3\text{PO}_4$  waste ( $\text{CaSO}_4$ )

1926-1951

E. I. DU PONT DE NEMOURS & CO.  
INDUSTRIAL AND BIOCHEMICALS DEPT.  
EAST CHICAGO, IND.

# DUPONT - EAST CHICAGO PLANT



# DUPONT - EAST CHICAGO PLANT

(N)

ILLIANA  
WAREHOUSE

PROPERTY LINE

RR TRACKS

MECHANICAL  
SHOPS

STG.

SHOPS

CREDIT  
UNION

RR SCALE

SHOPS

ELECTRICAL  
SHOP

CAR  
SHOP

AG-CHEM

SMALL  
CYLINDERS

A.H.F.

HOSPITAL

CHANGE  
HOUSE

SILICATE

REAGENTS

SULFAMIC

OFFICE

STG.  
STOREROOM

F.S.A.

OFFICE

FREON

SHOPS

RIVER

CONTACT  
#3

E. I. DU PONT DE NEMOURS & CO.  
INDUSTRIAL AND BIOCHEMICALS DEPT.  
EAST CHICAGO, IND.

*Flyash from coal burning*

KENNEDY AVE

BARREL  
HOUSE

MAIL  
OFFICE

SHIP OFFICE

ILLIANA  
WAREHOUSE

## AMMONIUM SULFAMATE

### ✓ AMMONIUM SULFAMATE \*

#### General Information

Synonym: Ammate.

Deliquescent crystalline material (white crystalline solid).

Formula:  $\text{NH}_4\text{OSO}_3\text{NH}_2$ .

Mol wt: 114.1, bp: 160°C (decomposes), mp: 131°C.

#### Hazard Analysis

Toxicology: A herbicide. Limited animal experiments

indicate moderate toxicity. Ingestion causes gastric irritation.

✓ Explosion Hazard: Slight, when exposed to heat or by spontaneous chemical reaction (hydrolysis); in a hot acid solution this material can undergo spontaneous hydrolysis liberating much heat.

Disaster Hazard: Dangerous. See sulfonates.

#### Countermeasures

Storage and Handling: Section 7.

### ✓ SULFONATES

#### Hazard Analysis

Toxicity: Variable. See specific compounds. Usually irritants.

Disaster Hazard: Dangerous; when heated to decomposition, or on contact with acid or acid fumes, they emit highly toxic fumes of  $\text{SO}_2$ .

#### Countermeasures

Storage and Handling: Section 7.

ASM

## AMMONIUM SULFAMATE

<b>Common Synonyms</b> Ammate Sulfamic acid, monommonium salt Ammonium amidosulfonate Ammonium amidosulphate AMS		
Solid	White or brownish-gray	Odorless
Sinks and mixes with water.		
Stop discharge if possible. Keep people away. Avoid contact with solid and dust. Isolate and remove discharged material. Notify local health and pollution control agencies.		
<b>Fire</b>	Not flammable. <b>POISONOUS GASES MAY BE PRODUCED IN FIRE.</b> Wear goggles and self-contained breathing apparatus.	
<b>Exposure</b>	<b>CALL FOR MEDICAL AID.</b> <b>DUST</b> Irritating to eyes, nose and throat. If inhaled will cause coughing or difficult breathing. If in eyes, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. <b>SOLID</b> Irritating to skin and eyes. If swallowed will cause nausea or vomiting. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If IN EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. If SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.	
<b>Water Pollution</b>	Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	

<b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook, CG 448-4) Disperse and flush	<b>2. LABELS</b>  No hazard label required by Code of Federal Regulations
<b>3. CHEMICAL DESIGNATIONS</b> 3.1 <b>Synonyms:</b> Ammate; Ammonium amidosulfonate; Ammonium amidosulphate; AMS; Sulfamic acid, monommonium salt 3.2 <b>Coast Guard Compatibility Classification:</b> Not listed 3.3 <b>Chemical Formula:</b> $\text{NH}_4\text{SO}_3\text{NH}_2$ 3.4 <b>IMCO/United Nations Numerical Designation:</b> Not listed	<b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 <b>Physical State (as shipped):</b> Solid 4.2 <b>Color:</b> White or brownish-gray 4.3 <b>Odor:</b> None
<b>5. HEALTH HAZARDS</b> 5.1 <b>Personal Protective Equipment:</b> Dust mask; goggles or face shield; rubber gloves. 5.2 <b>Symptoms Following Exposure:</b> Inhalation causes irritation of nose and throat. Ingestion causes gastrointestinal disturbances. Dust irritates eyes. 5.3 <b>Treatment for Exposure:</b> INHALATION: remove to fresh air. INGESTION: give large amount of water; get medical attention. EYES: flush with water for 15 min. SKIN: flush with water. 5.4 <b>Toxicity by Inhalation (Threshold Limit Value):</b> 10 mg/m <sup>3</sup> 5.5 <b>Short-Term Inhalation Limits:</b> Data not available 5.6 <b>Toxicity by Ingestion:</b> Grade 2; oral rat LD <sub>50</sub> = 1,600 mg/kg 5.7 <b>Late Toxicity:</b> Data not available 5.8 <b>Vapor (Gas) Irritant Characteristics:</b> Data not available 5.9 <b>Liquid or Solid Irritant Characteristics:</b> Data not available 5.10 <b>Odor Threshold:</b> Data not available	

<b>6. FIRE HAZARDS</b> <b>6.1 Flash Point:</b> Not flammable. <b>6.2 Flammable Limits in Air:</b> Not flammable. <b>6.3 Fire Extinguishing Agents:</b> Not pertinent. <b>6.4 Fire Extinguishing Agents Not to be Used:</b> Not pertinent. <b>6.5 Special Hazards of Combustion Products:</b> Toxic oxides of nitrogen may form in fires. <b>6.6 Behavior in Fire:</b> <b>6.7 Ignition Temperature:</b> Not pertinent. <b>6.8 Electrical Hazard:</b> Not pertinent. <b>6.9 Burning Rate:</b> Not pertinent.		<b>8. WATER POLLUTION</b> <b>8.1 Aquatic Toxicity:</b> 259 ppm/24 hr/catfish/50% kill/fresh water. <b>8.2 Waterfowl Toxicity:</b> Data not available. <b>8.3 Biological Oxygen Demand (BOD):</b> Data not available. <b>8.4 Food Chain Concentration Potential:</b> None.	
<b>7. CHEMICAL REACTIVITY</b> <b>7.1 Reactivity with Water:</b> No reaction. <b>7.2 Reactivity with Common Materials:</b> <b>7.3 Stability During Transport:</b> Stable. <b>7.4 Neutralizing Agents for Acids and Caustics:</b> Not pertinent. <b>7.5 Polymerization:</b> Not pertinent. <b>7.6 Inhibitor of Polymerization:</b> Not pertinent.		<b>9. SELECTED MANUFACTURERS</b> 1. Heico, Inc. Delaware Water Gap, Pa. 18327 2. Gallard-Schlesinger Chemical Mfg. Co. 384 Muncula Ave. Carle Place, N.Y. 11514 3. Pfaltz and Bauer, Inc. 126-04 Northern Blvd. Flushing, N.Y. 11368	
<b>11. HAZARD ASSESSMENT CODE</b> <small>(See Hazard Assessment Handbook, CG 448-3)</small> SS		<b>10. SHIPPING INFORMATION</b> <b>10.1 Grades or Purities:</b> Reagent, 99.0%; Commercial, 80%. <b>10.2 Storage Temperature:</b> Ambient. <b>10.3 Inert Atmosphere:</b> No requirement. <b>10.4 Venting:</b> Open.	
<b>12. HAZARD CLASSIFICATIONS</b> <b>12.1 Code of Federal Regulations:</b> Not listed. <b>12.2 NAS Hazard Rating for Bulk Water Transportation:</b> Not listed. <b>12.3 NFPA Hazard Classifications:</b> Not listed.		<b>13. PHYSICAL AND CHEMICAL PROPERTIES</b> <b>13.1 Physical State at 15°C and 1 atm:</b> Solid. <b>13.2 Molecular Weight:</b> 114.13. <b>13.3 Boiling Point at 1 atm:</b> Decomposes above 200°C. <b>13.4 Freezing Point:</b> 268°F = 131°C = 404°K. <b>13.5 Critical Temperature:</b> Not pertinent. <b>13.6 Critical Pressure:</b> Not pertinent. <b>13.7 Specific Gravity:</b> > 1 at 20°C (solid). <b>13.8 Liquid Surface Tension:</b> Not pertinent. <b>13.9 Liquid-Water Interfacial Tension:</b> Not pertinent. <b>13.10 Vapor (Gas) Specific Gravity:</b> Not pertinent. <b>13.11 Ratio of Specific Heats of Vapor (Gas):</b> Not pertinent. <b>13.12 Latent Heat of Vaporization:</b> Not pertinent. <b>13.13 Heat of Combustion:</b> Not pertinent. <b>13.14 Heat of Decomposition:</b> Not pertinent. <b>13.15 Heat of Solution:</b> Data not available. <b>13.16 Heat of Polymerization:</b> Not pertinent.	

(Continued on pages 5 and 6)

## NOTES



## ANTIMONY PENTACHLORIDE AND HYDROCHLORIC ACID

### ✓ **ANTIMONY PENTACHLORIDE**

#### **General Information**

Synonyms: antimonie chloride; antimony perchloride.

Reddish-yellow, oily liquid, offensive odor.

Formula:  $\text{SbCl}_5$ .

Mol wt: 299.05, mp:  $2.8^\circ\text{C}$ , bp:  $79^\circ\text{C}$  at 22 mm, d: (liq)

2.336, vap. press.: 1 mm at  $22.7^\circ\text{C}$ .

#### **Hazard Analysis and Countermeasures**

See antimony compounds and hydrochloric acid.

Shipping Regulations: Section 11.

Regulated by CG, DOT, IATA.

### ✓ **ANTIMONY COMPOUNDS \***

#### **Hazard Analysis**

Toxic Hazard Rating:

Acute Local: Ingestion 3.

Acute Systemic: Ingestion 3; Inhalation 3.

Chronic Local: Irritant 2.

Chronic Systemic: Ingestion 3; Inhalation 3.

Toxicology: Because of the association with lead and arsenic in industry, it is often difficult to assess the toxicity of antimony and its compounds. Animals exposed to fumes of antimony oxide have developed pneumonitis, fatty degeneration of the liver, a decreased leucocyte count affecting in particular the polymorphonuclears, and damage to the heart muscle. In humans, complaints referable to the nervous system have been reported. In assessing human cases, however, the possibility of lead or arsenical poisoning must always be borne in mind. Locally antimony compounds are irritant to the skin and mucous membranes.

Signs and symptoms may include irritation and eczematous eruption of the skin, inflammation of the mucous membranes of the nose and throat, metallic taste and stomatitis, gastrointestinal upset, with vomiting and diarrhea, and various nervous complaints, such as irritability, sleeplessness, fatigue, dizziness and muscular and neuralgic pains. See also specific compounds.

#### **Countermeasures**

Ventilation Control: Section 2.

Personnel Protection: Section 2.

First Aid: Section 9.

Storage and Handling: Section 7.

### ✓ **HYDROCHLORIC ACID \***

#### **General Information**

Synonyms: muriatic acid; chlorohydric acid; hydrogen chloride.

Colorless gas or colorless, fuming liquid; strongly corrosive.

Formula:  $\text{HCl}$ .

Mol wt: 36.47, mp:  $-114.3^\circ\text{C}$ , bp:  $-84.8^\circ\text{C}$ , d: 1.639

g/liter (gas) at  $0^\circ\text{C}$ ; 1.194 at  $-36^\circ\text{C}$  (liquid), vap.

press.: 4.0 atm at  $17.8^\circ\text{C}$ .

#### **Hazard Analysis**

Toxic Hazard Rating:

Acute Local: Irritant 3.

Acute Systemic: Ingestion 3; Inhalation 3.

Chronic Local: Irritant 2.

Chronic Systemic: U.

Toxicology: Hydrochloric acid is an irritant to the mucous membranes of the eyes and respiratory tract, and a concentration of 35 ppm causes irritation of the throat after short exposure. Concentrations of 50 to 100 ppm are tolerable for 1 hour. More severe exposures result in pulmonary edema, and often laryngeal spasm. Concentrations of 1,000 to 2,000 ppm are dangerous, even for brief exposures. Mists of hydrochloric acid are considered less harmful than the anhydrous hydrogen chloride, since the droplets have no dehydrating action. In general, hydrochloric acid causes little trouble in industry, other than from accidental splashes and burns. It is used as a general purpose food additive (Section 10). It is a common air contaminant.

Disaster Hazard: Dangerous; see chlorides; will react with water or steam to produce toxic and corrosive fumes.

#### **Countermeasures**

Ventilation Control: Section 2.

Personnel Protection: Section 2.

Storage and Handling: Section 7.

Shipping Regulations: Section 11.

Regulated by IATA, CG, DOT.


**HYDROCHLORIC ACID MIXTURES.** See hydrochloric acid.

Shipping Regulations: Section 11.

Regulated by CG, DOT.

APC

## ANTIMONY PENTACHLORIDE


Common Synonyms Antimony (V) chloride Antimony perchloride		Liquid	Colorless to brown	Unpleasant odor
Sinks in water. Irritating vapor is produced. Freezing point is 379°F.				
Avoid contact with liquid. Keep people away. Wear rubber overclothing (including gloves). Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		Not flammable. POISONOUS GASES ARE PRODUCED WHEN HEATED. DO NOT USE WATER ON ADJACENT FIRES.		
Exposure		Call for medical aid.  VAPOR Irritating to eyes, nose and throat. If inhaled will cause coughing or difficult breathing. Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.  LIQUID Will burn skin and eyes. If swallowed will cause nausea, vomiting or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.		
Water Pollution		Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook, CG 448-4) Issue warning Restrict access Disperse and flush		2. LABEL 		
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Antimony (V) chloride Antimony perchloride 3.2 Coast Guard Compatibility Classification: Not applicable 3.3 Chemical Formula: SbCl <sub>5</sub> 3.4 IMCO/United Nations Numerical Designation: 8/1730		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to medium brown, yellow, red-brown 4.3 Odor: Pungent, offensive		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Organic vapor/acid gas type canister mask; rubber, neoprene, vinyl, etc. gloves; chemical safety goggles; plus face shield where appropriate; acid-resistant clothing; plus apron for splash protection; rubber safety shoes or boots; hard hat. 5.2 Symptoms Following Exposure: Inhalation causes irritation of nose and throat. Contact of liquid with eyes or skin causes severe burns. Ingestion causes vomiting and severe burns of mouth and stomach. Overexposure by any route can cause bloody stools, slow pulse, low blood pressure, coma, convulsions, cardiac arrest. 5.3 Treatment for Exposure: INHALATION: remove to clean air; rinse mouth and gargle with water; if overexposure is serious, get prompt medical attention. EYES: flush eyes and eye-lids thoroughly with large amounts of water; get prompt medical attention. SKIN: flush thoroughly with water; remove contaminated clothing; wash affected area with soap and water; if overexposure is serious, get prompt medical attention. INGESTION: dilute by drinking water; if vomiting occurs, administer more water. If overexposure is serious, get prompt medical attention. 5.4 Toxicity by Inhalation (Threshold Limit Value): 0.5 mg/m <sup>3</sup> as antimony 5.5 Short-Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 2; oral LD <sub>50</sub> = 1,115 mg/kg (rat), 900 mg/kg (guinea pig) 5.7 Late Toxicity: Antimony poisoning may result. 5.8 Vapor (Gas) Irritant Characteristics: Vapors are moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations.				

(Continued on page 6)

<b>6. FIRE HAZARDS</b> 6.1 <b>Flash Point:</b> Not flammable 6.2 <b>Flammable Limits in Air:</b> Not flammable 6.3 <b>Fire Extinguishing Agents:</b> Not pertinent 6.4 <b>Fire Extinguishing Agents Not to be Used:</b> Do not use water or foam on adjacent fires. 6.5 <b>Special Hazards of Combustion Products:</b> Not pertinent 6.6 <b>Behavior in Fire:</b> Irritating fumes of hydrogen chloride given off when water or foam is used to extinguish adjacent fire. 6.7 <b>Ignition Temperature:</b> Not pertinent 6.8 <b>Electrical Hazard:</b> Not pertinent 6.9 <b>Burning Rate:</b> Not pertinent		<b>8. WATER POLLUTION</b> 8.1 <b>Aquatic Toxicity:</b> Data not available 8.2 <b>Waterfowl Toxicity:</b> Data not available 8.3 <b>Biological Oxygen Demand (BOD):</b> None 8.4 <b>Food Chain Concentration Potential:</b> None																													
<b>7. CHEMICAL REACTIVITY</b> 7.1 <b>Reactivity with Water:</b> Reacts to form hydrogen chloride gas (hydrochloric acid) 7.2 <b>Reactivity with Common Materials:</b> Causes corrosion of metal. 7.3 <b>Stability During Transport:</b> Stable 7.4 <b>Neutralizing Agents for Acids and Caustics:</b> Soda ash or soda ash-lime mixture 7.5 <b>Polymerization:</b> Not pertinent 7.6 <b>Inhibitor of Polymerization:</b> Not pertinent		<b>9. SELECTED MANUFACTURERS</b> 1. Hooker Chemical Corporation Specialty Chemicals Division 4700 Buffalo Avenue Niagara Falls, N. Y. 14302 2. J. T. Baker Chemical Co. Phillipsburg, N. J. 08860 3. Mallinckrodt Chemical Works 223 West Side Avenue Jersey City, N. J. 07304																													
<b>11. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook, CG 448-3) A-O		<b>10. SHIPPING INFORMATION</b> 10.1 <b>Grade or Purity:</b> 90+ % 10.2 <b>Storage Temperature:</b> Ambient 10.3 <b>Inert Atmosphere:</b> No requirement 10.4 <b>Venting:</b> Pressure/vacuum																													
<b>12. HAZARD CLASSIFICATIONS</b> 12.1 <b>Code of Federal Regulations:</b> Corrosive 12.2 <b>NAS Hazard Rating for Bulk Water Transportation:</b> <table><tr><th>Category</th><th>Rating</th></tr><tr><td>Fire</td><td>0</td></tr><tr><td>Health</td><td></td></tr><tr><td>Vapor Irritant</td><td>3</td></tr><tr><td>Liquid or Solid Irritant</td><td>4</td></tr><tr><td>Poisonous</td><td>3</td></tr><tr><td>Water Pollution</td><td></td></tr><tr><td>Human Toxicity</td><td>3</td></tr><tr><td>Aquatic Toxicity</td><td>3</td></tr><tr><td>Aesthetic Effect</td><td>2</td></tr><tr><td>Reactivity</td><td></td></tr><tr><td>Other Chemicals</td><td>3</td></tr><tr><td>Water</td><td>3</td></tr><tr><td>Self-Reaction</td><td>0</td></tr></table> 12.3 <b>NFPA Hazard Classifications:</b> Not listed		Category	Rating	Fire	0	Health		Vapor Irritant	3	Liquid or Solid Irritant	4	Poisonous	3	Water Pollution		Human Toxicity	3	Aquatic Toxicity	3	Aesthetic Effect	2	Reactivity		Other Chemicals	3	Water	3	Self-Reaction	0	<b>13. PHYSICAL AND CHEMICAL PROPERTIES</b> 13.1 <b>Physical State at 15°C and 1 atm:</b> Liquid 13.2 <b>Molecular Weight:</b> 299.05 13.3 <b>Boiling Point at 1 atm:</b> (est.) 347°F = 175°C = 448°K 13.4 <b>Freezing Point:</b> 374°F = 190°C = 462°K 13.5 <b>Critical Temperature:</b> Not pertinent 13.6 <b>Critical Pressure:</b> Not pertinent 13.7 <b>Specific Gravity:</b> 2.354 at 20°C (liquid) 13.8 <b>Liquid Surface Tension:</b> (est.) 3.15 dynes/cm = 0.015 N/m at 20°C 13.9 <b>Liquid-Water Interfacial Tension:</b> Not pertinent 13.10 <b>Vapor (Gas) Specific Gravity:</b> Not pertinent 13.11 <b>Ratio of Specific Heats of Vapor (Gas):</b> Not pertinent 13.12 <b>Latent Heat of Vaporization:</b> 68.9 Btu/lb = 38.3 cal/g = 1.60 × 10 <sup>5</sup> J/kg 13.13 <b>Heat of Combustion:</b> Not pertinent 13.14 <b>Heat of Decomposition:</b> Not pertinent 13.15 <b>Heat of Solution:</b> -211.9 Btu/lb = -117.7 cal/g = -4.925 × 10 <sup>3</sup> J/kg 13.16 <b>Heat of Polymerization:</b> Not pertinent	
Category	Rating																														
Fire	0																														
Health																															
Vapor Irritant	3																														
Liquid or Solid Irritant	4																														
Poisonous	3																														
Water Pollution																															
Human Toxicity	3																														
Aquatic Toxicity	3																														
Aesthetic Effect	2																														
Reactivity																															
Other Chemicals	3																														
Water	3																														
Self-Reaction	0																														
(Continued on pages 5 and 6)																															
<b>5. HEALTH HAZARDS (Cont'd.)</b> 5.9 <b>Liquid or Solid Irritant Characteristics:</b> Severe skin irritant; causes second- and third-degree burns on short contact and is very injurious to the eyes. 5.10 <b>Odor Threshold:</b> Data not available																															

HCL

## HYDROCHLORIC ACID

Common Synonyms: Muriatic Acid		Wettable Liquid	Colorless	Sharp, irritating odor
Sinks and mixes with water. Irritating vapor is produced.				
AVOID CONTACT WITH LIQUID AND VAPOR. Keep people away. Wear chemical protective suit with self-contained breathing apparatus. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		Not flammable. Flammable gas may be produced on contact with metals. Wear chemical protective suit with self-contained breathing apparatus.		
Exposure		CALL FOR MEDICAL AID VAPOR Irritating to eyes, nose and throat. If inhaled, will cause coughing or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.		
Water Pollution		Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook, CG 444-4) Issue warning - corrosive Restrict access Disperse and flush		2. LABEL 		
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Muriatic acid 3.2 Coast Guard Compatibility Classification: Non-oxidizing mineral acid 3.3 Chemical Formula: HCl (H <sub>2</sub> O) 3.4 IMCO/United Nations Numerical Designation: 8 U/1789		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to light yellow 4.3 Odor: Pungent; sharp, pungent, irritating		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Self-contained breathing equipment, air-line mask, or industrial canister-type gas mask; rubber or rubber-coated gloves, apron, coat, overalls, shoes. 5.2 Symptoms Following Exposure: Inhalation of fumes results in coughing and choking sensation, and irritation of nose and lungs. Liquid causes burns. 5.3 Treatment for Exposure: INHALATION: remove person to fresh air; keep him warm and quiet and get medical attention immediately; start artificial respiration if breathing stops. INGESTION: have person drink water or milk; do NOT induce vomiting. EYES: immediately flush with plenty of water for at least 15 min. and get medical attention; continue flushing for another 15 min. if physician does not arrive promptly. SKIN: immediately flush skin while removing contaminated clothing; get medical attention promptly; use soap and wash area for at least 15 min. 5.4 Toxicity by Inhalation (Threshold Limit Value): 5 ppm 5.5 Short-Term Inhalation Limits: 5 ppm for 5 min. 5.6 Toxicity by Ingestion: Data not available 5.7 Late Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations. 5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant; may cause pain and second-degree burns after a few minutes' contact. 5.10 Odor Threshold: 1-5 ppm				

## 6. FIRE HAZARDS

- 6.1 **Flash Point:** Not flammable  
6.2 **Flammable Limits in Air:** Not flammable  
6.3 **Fire Extinguishing Agents:** Not pertinent  
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent  
6.5 **Special Hazards of Combustion Products:** Toxic and irritating vapors are generated when heated  
6.6 **Behavior in Fire:** Not pertinent  
6.7 **Ignition Temperature:** Not flammable  
6.8 **Electrical Hazard:** Not pertinent  
6.9 **Burning Rate:** Not flammable

## 7. CHEMICAL REACTIVITY

- 7.1 **Reactivity with Water:** No reaction  
7.2 **Reactivity with Common Materials:** Corrosive to most metals with evolution of hydrogen gas, which may form explosive mixtures with air.  
7.3 **Stability During Transport:** Stable  
7.4 **Neutralizing Agents for Acids and Caustics:** Flush with water; apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate.  
7.5 **Polymerization:** Not pertinent  
7.6 **Inhibitor of Polymerization:** Not pertinent

## 8. WATER POLLUTION

- 8.1 **Aquatic Toxicity:** 252 ppm/96 hr/mosquito fish/TL<sub>50</sub>/fresh water  
100-150 ppm/48 hr/shrimp/TL<sub>50</sub>/salt water  
8.2 **Waterfowl Toxicity:** Data not available  
8.3 **Biological Oxygen Demand (BOD):** None  
8.4 **Food Chain Concentration Potential:** None

## 9. SELECTED MANUFACTURERS

1. Diamond Shamrock Corp.  
Electrochemicals Division  
300 Union Commerce Bldg.  
Cleveland, Ohio 44115
2. Stauffer Chemical Co.  
Industrial Chemicals Division  
299 Park Ave.  
New York, N. Y. 10017
3. Vulcan Materials Co.  
Chemicals Division  
Wichita, Kan. 67201

## 10. SHIPPING INFORMATION

- 10.1 **Grades or Purities:** Food processing or technical:  
18° Be 27.9%, 20 Be 31.3%,  
22° Be 35.2%,  
Reagent, ACS, and USP: 23° Be 37.1%  
10.2 **Storage Temperature:** Ambient  
10.3 **Inert Atmosphere:** No requirement  
10.4 **Venting:** Open

## 11. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook, CG 448-3)  
A-P

## 12. HAZARD CLASSIFICATIONS

- 12.1 **Code of Federal Regulations:** Corrosive material  
12.2 **NAB Hazard Rating for Bulk Water Transportation:**
- | Category                 | Rating |
|--------------------------|--------|
| Fire                     | 0      |
| Health                   |        |
| Vapor Irritant           | 3      |
| Liquid or Solid Irritant | 3      |
| Poisons                  | 2      |
| Water Pollution          |        |
| Human Toxicity           | 2      |
| Aquatic Toxicity         | 2      |
| Aesthetic Effect         | 2      |
| Reactivity               |        |
| Orbital Chemicals        | 3      |
| Water                    | 0      |
| Self-Reaction            | 0      |
- 12.3 **NFPA Hazard Classifications:**
- | Category             | Classification |
|----------------------|----------------|
| Health Hazard (Blue) | 3              |
| Flammability (Red)   | 0              |
| Reactivity (Yellow)  | 0              |

## 13. PHYSICAL AND CHEMICAL PROPERTIES\*

- 13.1 **Physical State at 15°C and 1 atm:** Liquid  
13.2 **Molecular Weight:** Not pertinent  
13.3 **Boiling Point at 1 atm:** 123°F = 50.5°C = 323 K  
13.4 **Freezing Point:** Not pertinent  
13.5 **Critical Temperature:** Not pertinent  
13.6 **Critical Pressure:** Not pertinent  
13.7 **Specific Gravity:** 1.19 at 20°C (liquid)  
13.8 **Liquid Surface Tension:** Not pertinent  
13.9 **Liquid-Water Interfacial Tension:** Not pertinent  
13.10 **Vapor (Gas) Specific Gravity:** Not pertinent  
13.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent  
13.12 **Latent Heat of Vaporization:** 178 Btu/lb = 98.6 cal/g = 4.13 x 10<sup>3</sup> J/kg  
13.13 **Heat of Combustion:** Not pertinent  
13.14 **Heat of Decomposition:** Not pertinent  
13.15 **Heat of Solution:** -860 Btu/lb = -480 cal/g = -20 x 10<sup>3</sup> J/kg  
13.16 **Heat of Polymerization:** Not pertinent  
\*Physical properties apply to 37% solution.

NOTES

(Continued on pages 5 and 6)

# CALCIUM ARSENATE, LEAD ARSENATE AND ARSENIC TRIOXIDE

## CALCIUM ARSENATE \*

### General Information

Synonyms: tricalcium *o*-arsenate; calcium *o*-arsenate.

White, amorphous powder.

Formula:  $\text{Ca}_3(\text{AsO}_4)_2$ .

Mol wt: 398.06, d: 3.620.

### Hazard Analysis

Toxicity: Highly toxic. A recognized carcinogen, Section 8. An insecticide and herbicide. Acute oral  $\text{LD}_{50}$  = 35-100 mg/kg. See arsenic compounds.

### Countermeasures

Storage and Handling: Section 7.

Shipping Regulations: Section 11.

Regulated by CG, DOT, IATA.

## LEAD ARSENATES \*

### General Information

Synonyms: lead *o*-arsenate; lead di-*o*-arsenate; lead mono-*o*-arsenate; lead pyro-arsenate; lead *m*-arsenate.

White crystals.

### Hazard Analysis

Toxicity: Highly toxic. See lead compounds and arsenic compounds. A recognized carcinogen (Section 8).

Disaster Hazard: Dangerous; on heating, it emits highly toxic fumes.

### Countermeasures

Storage and Handling: Section 7.

Shipping Regulations: Section 11.

Regulated by CG, DOT, IATA.

## ARSENIC TRIOXIDE

### General Information

Synonyms: white arsenic.

White, odorless, tasteless, amorphous powder.

Formula:  $\text{As}_2\text{O}_3$ .

Mol wt: 197.8, mp: 315°C (sublimes), d: (arsenolite) 3.865 at 25°C; (claudeite) 4.15; (amorphous) 4.09.

### Hazard Analysis

Toxicity: A rodenticide. See arsenic compounds.

Disaster Hazard: See arsenic compounds.

### Countermeasures

Ventilation Control: Section 2.

Personnel Protection: Section 2.

First Aid: Section 9.

Storage and Handling: Section 7.

Shipping Regulations: Section 11.

Regulated by CG, DOT, IATA.

## ARSENIC COMPOUNDS. \* See also specific compound.

### General Information

Synonym: arsenicals.

### Hazard Analysis

Toxic Hazard Rating:

Acute Local: Irritant 2; Allergen 2; Ingestion 3.

Acute Systemic: Ingestion 3; Inhalation 3.

Chronic Local: Irritant 2, Allergen 2.

Chronic Systemic: Ingestion 3, Inhalation 3.

Toxicology: Used as insecticides, herbicides, silvicides, defoliants, desiccants and rodenticides. Poisoning from arsenic compounds may be acute or chronic. Acute poisoning usually results from swallowing arsenic compounds; chronic poisoning from either swallowing or inhalation. Acute allergic reactions to arsenic compounds used in medical therapy have been fairly common. The type and severity of reaction depending upon the compound of arsenic.

Acute arsenic poisoning (from ingestion) results in marked irritation of the stomach and intestines with nausea, vomiting and diarrhea. In severe cases the vomitus and stools are bloody and the patient goes into collapse and shock with weak, rapid pulse, cold sweats, coma and death.

Chronic arsenic poisoning, whether through ingestion or inhalation, may manifest itself in many different ways. There may be disturbances of the digestive system such as loss of appetite, cramps, nausea, constipation or diarrhea. Liver damage may occur, resulting in jaundice. Disturbances of the blood, kidneys and nervous system are not infrequent. Arsenic can cause a variety of skin abnormalities including itching, pigmentation and even cancerous changes. A characteristic of arsenic poisoning is the great variety of symptoms that can be produced. A recognized carcinogen of the skin, lungs, liver. An experimental carcinogen of the mouth, esophagus, larynx, bladder and para nasal sinus. Section 8.

In treating acute poisoning from ingestion BAL (dimercaptol) is of questionable effectiveness for acute and chronic poisoning with trivalent arsenicals, such as  $\text{As}_2\text{O}_3$ , arsine and arsenites. It is of no value for pentavalent arsenicals, such as cacodylic acid, methanearsonic acid, sodium, cacodylate, MSMA, DSMA, arsanilic acid, arsenic acid, and arsenates. Vomiting and gastric lavage are the preferred emergency treatments for acute arsenical poisoning. Modern medical treatment of arsenical poisoning uses exchange transfusion and dialysis (A. E. De Palma, *J. Occup. Med.*, Vol. 11, 582-587 (1969). Note: Arsenic compounds are common air contaminants.

Disaster Hazard: Dangerous; when heated to decompo-

sition or for metallic As on contact with acids or acid fumes or when water solutions of arsenicals are in contact with active metals such as Fe, Al, Zn, it emits highly toxic fumes of As.

### Countermeasures

Ventilation Control: Section 2.

Personnel Protection: Section 2.

## LEAD COMPOUNDS \*

### Hazard Analysis

Toxic Hazard Rating:

Acute Local: 0.

Acute Systemic: Ingestion 3; Inhalation 3.

Chronic Local: 0.

Chronic Systemic: Ingestion 3; Inhalation 3; Skin Absorption 3.

Toxicology: Lead poisoning is one of the commonest of occupational diseases. The presence of lead-bearing materials or lead compounds in an industrial plant does not necessarily result in exposure on the part of the workman. The lead must be in such form, and so distributed, as to gain entrance into the body or tissues of the workman in measurable quantity, otherwise no exposure can be said to exist. It is a

suspected carcinogen of the lungs and kidneys (Section 8).

Mode of entry into body:

1. By inhalation of the dusts, fumes, mists or vapors. (Common air contaminants).
2. By ingestion of lead compounds trapped in the upper respiratory tract or introduced into the mouth on food, tobacco, fingers or other objects.
3. Through the skin; this route is of special importance in the case of organic compounds of lead, as lead tetraethyl. In the case of the inorganic forms of lead, this route is of no practical importance.

Physiological Action and Toxicity: When lead is ingested, much of it passes through the body unabsorbed, and is eliminated in the feces. The greater portion of the lead that is absorbed is caught by the liver and excreted, in part, in the bile. For this reason, larger amounts of lead are necessary to cause poisoning if absorption is by this route, and a longer period of exposure is usually necessary to produce symptoms. On the other hand, when lead is inhaled, absorption takes place easily from the respiratory tract and symptoms tend to develop more quickly. From the point of view of industrial poisoning, inhalation of lead is much more important than is ingestion.

Lead is a cumulative poison. Increasing amounts build up in the body and eventually a point is reached where symptoms and disability occur.

Lead produces a brittleness of the red blood cells so that they hemolyze with but slight trauma; the hemoglobin is not affected. Due to their increased fragility, the red cells are destroyed more rapidly in the body than normally, producing an anemia which is rarely severe. The loss of circulating red cells stimulates the production of new young cells which, on entering the blood stream, are acted upon by the circulating lead, with resultant coagulation of their basophilic material. These cells after suitable staining, are recognized as "stippled cells." As regards the effect of lead on the white blood cells, there is no uniformity of opinion. In addition to its effect on the red cells of the blood, lead produces a damaging effect on the organs or tissues with which it comes in contact. No specific or characteristic lesion is produced. Autopsies of deaths attributed to lead poisoning and experimental work on animals, have shown pathological lesions of the kidneys, liver, male gonads, nervous system, blood vessels and other tissues. None of these changes, however, have been found consistently.

In cases of lead poisoning, the amount of lead found in the blood is frequently in excess of 0.07 mg per 100 cc of whole blood. The urinary lead excretion generally exceeds 0.1 mg per liter of urine.

The toxicity of the various lead compounds appears to depend upon several factors: (1) the solubility of the compound in the body fluids; (2) the fineness of the particles of the compound; solubility is greater, of course, in proportion to the fineness of the particles; (3) conditions under which the compound is being used; where a lead compound is used as a powder, contamination of the

atmosphere will be much less where the powder is kept damp. Of the various lead compounds, the carbonate, the monoxide and sulfate are considered to be more toxic than metallic lead or other lead compounds. Lead arsenate is very toxic, due to the presence of the arsenic radical.

Signs and Symptoms: Industrial lead poisoning commonly occurs following prolonged exposure to lead or its compounds. The common clinical types of lead poisoning may be classified according to their clinical picture as (a) alimentary; (b) neuromotor; and (c) encephalic. Some cases may show a combination of clinical types. The alimentary type occurs most frequently, and is characterized by abdominal discomfort or pain. Severe cases may present actual colic. Other complaints are constipation and/or diarrhea, loss of appetite, metallic taste, nausea and vomiting, lassitude, insomnia, weakness, joint and muscle pains, irritability, headache and dizziness. Pallor, lead line on the gums, pyorrhea, loss of weight, abdominal tenderness, basophilic stippling, anemia, slight albuminuria, increased urinary excretion, and an increase in the lead content of the whole blood, are signs which may accompany the above symptoms.

In the neuromuscular type, the chief complaint is weakness, frequently of the extensor muscles of the wrist and hand, unilateral or bilateral. Other muscle groups which are subject to constant use may be affected. Gastroenteric symptoms are usually present, but are not as severe as in the alimentary type of poisoning. Joint and muscle pains are likely to be more severe. Headache, dizziness and insomnia are frequently prominent. True paralysis is uncommon, and usually is the result of prolonged exposure.

Lead encephalopathy is the most severe but the rarest manifestation of lead poisoning. In the industrial worker it follows rapid and heavy lead absorption. Organic lead compounds, such as tetraethyl lead, are absorbed rapidly through the skin as well as through the lungs, and are selectively absorbed by the central nervous system. The clinical picture in these cases is usually an encephalopathy. With inorganic lead compounds, comparable concentrations in the central nervous system are reached only when the workplace is heavily contaminated with vapor, fume and dust. Encephalopathy begins abruptly, and is characterized by signs of cerebral and meningeal involvement. There is usually stupor, progressing to coma, with or without convulsion, and often terminating in death. Excitation, confusion and mania are less common. In milder cases of short duration, there may be symptoms of headache, dizziness, somnolence and insomnia. The cerebrospinal pressure may be increased. See also specific compound.

Diagnosis: A diagnosis of lead poisoning should not be made on the basis of any single clinical or laboratory finding. There must be a history of significant exposure, signs, and symptoms (as described above) compatible with the diagnosis, and confirmatory laboratory tests. Increase of stippled red blood cells, mild anemia, and elevated lead in blood and urine, i.e., more than 0.07 mg/100 ml blood and similar values per liter of urine. An increase of coproporphyrins and certain amino acids in urine may be present. Diagnostic mobilization of lead with calcium EDTA may be useful in questionable cases.



Treatment of Lead Poisoning: It has been found that the chelating agent, calcium ethylenediamine tetracetate, and related compounds are highly efficacious in removing absorbed lead from the tissues of the body. (The therapeutic agents of this group are also known as versene, versenate, edathamil and Ca EDTA.)

Ca EDTA is effective only when administered intravenously. Various dosage schedules have been proposed. An effective regime is 3 to 6 grams of Na Ca EDTA in 300 cc to 500 cc of 5 percent glucose by intravenous drip over a period of 3 to 8 hours. Treatment may be given daily for 5 to 10 days with an interval of one week between courses. Another plan is to give treatment at intervals of 3 to 5 days until deleading has been accomplished.

Disaster Hazard: See lead.

CCA

## CALCIUM ARSENATE

Common Synonyms Tricalcium arsenate Tricalcium ortho arsenate Cucumber dust		Solid	White	Odorless
Sinks in water.				
AVOID CONTACT WITH SOLID AND DUST. KILL PEOPLE AWAY. Wear a dust respirator. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		Not flammable. POISONOUS GASES MAY BE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus.		
 Exposure		CALL FOR MEDICAL AID. DUST POISONOUS IF INHALED. If inhaled will cause coughing or difficult breathing. If in eyes, hold eyelids open and flush with plenty of water. If breathing is difficult, give oxygen. SOLID POISONOUS IF SWALLOWED. If swallowed will cause nausea and vomiting. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.		
Water Pollution		HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and welfare officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook, CG 446-4) Issue warning: poison, water contaminant. Restrict access. Should be removed. Chemical and physical treatment.		2. LABEL 		
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Cucumber dust Tricalcium arsenate Tricalcium orthoarsenate 3.2 Coast Guard Compatibility Classification: Not listed 3.3 Chemical Formula: $\text{Ca}_3(\text{AsO}_4)_2$ 3.4 IMCO/United Nations Numerical Designation: 6.1/1573		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: White 4.3 Odor: None		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Dust mask; goggles or face shield; protective gloves. 5.2 Symptoms Following Exposure: Inhalation causes respiratory irritation. Ingestion causes irritation of mouth and stomach. Contact with eyes causes irritation. 5.3 Treatment for Exposure: INHALATION: move to fresh air. INGESTION: give victim one tablespoonful of salt in glass of water; repeat until vomit is clear; then give 2 tablespoonfuls of Epsom salts or milk of magnesia and force fluids; call a physician in all cases of suspected poisoning. EYES: flush with water for at least 15 min. SKIN: flush with water; wash with soap and water. 5.4 Toxicity by Inhalation (Threshold Limit Value): Imp/yr 5.5 Short-Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 4; oral rat $\text{LD}_{50}$ = 20 mg/kg 5.7 Late Toxicity: Arsenic compounds may cause skin and lung cancer. 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available				

## 6. FIRE HAZARDS

- 6.1 **Flash Point:** Not flammable  
6.2 **Flammable Limits in Air:** Not flammable  
6.3 **Fire Extinguishing Agents:** Not pertinent  
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent  
6.5 **Special Hazards of Combustion Products:** Toxic arsenic fumes may be formed in fires.  
6.6 **Behavior in Fire:**  
6.7 **Ignition Temperature:** Not pertinent  
6.8 **Electrical Hazard:** Not pertinent  
6.9 **Burning Rate:** Not pertinent

## 8. WATER POLLUTION

- 8.1 **Aquatic Toxicity:**  
1.1 ppm/48 hr/perch/toxic/fresh water  
4.3 ppm/264 hr/crabs/toxic/fresh water  
8.2 **Waterfowl Toxicity:** Data not available  
8.3 **Biological Oxygen Demand (BOD):** None  
8.4 **Food Chain Concentration Potential:** Possible bioaccumulation problem

## 9. SELECTED MANUFACTURERS

- Los Angeles Chemical Co  
4545 Ardine Street  
South Gate, Calif. 90280
- Pfaltz and Bauer, Inc.  
126 - 04 Northern Blvd.  
Flushing, N. Y. 11368

## 7. CHEMICAL REACTIVITY

- 7.1 **Reactivity with Water:** No reaction  
7.2 **Reactivity with Common Materials:**  
7.3 **Stability During Transport:** Stable  
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent  
7.5 **Polymerization:** Not pertinent  
7.6 **Inhibitor of Polymerization:** Not pertinent

## 10. SHIPPING INFORMATION

- 10.1 **Grade or Purity:** 70%, containing calcium carbonate and calcium hydroxide (limestone and slaked lime)  
10.2 **Storage Temperature:** Ambient  
10.3 **Inert Atmosphere:** No requirement  
10.4 **Venting:** Open

## 11. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook, CG 446-3)  
II

## 12. HAZARD CLASSIFICATIONS

- 12.1 **Code of Federal Regulations:**  
Poisonous solid, Class II  
12.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed  
12.3 **HFFA Hazard Classifications:** Not listed

## 13. PHYSICAL AND CHEMICAL PROPERTIES



- 13.1 **Physical State at 15°C and 1 atm:** Solid  
13.2 **Molecular Weight:** 398  
13.3 **Boiling Point at 1 atm:** Not pertinent (decomposes)  
13.4 **Freezing Point:** Not pertinent  
13.5 **Critical Temperature:** Not pertinent  
13.6 **Critical Pressure:** Not pertinent  
13.7 **Specific Gravity:** 3.62 at 20°C (solid)  
13.8 **Liquid Surface Tension:** Not pertinent  
13.9 **Liquid-Water Interfacial Tension:** Not pertinent  
13.10 **Vapor (Gas) Specific Gravity:** Not pertinent  
13.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent  
13.12 **Latent Heat of Vaporization:** Not pertinent  
13.13 **Heat of Combustion:** Not pertinent  
13.14 **Heat of Decomposition:** Not pertinent  
13.15 **Heat of Solution:** Not pertinent  
13.16 **Heat of Polymerization:** Not pertinent

(Continued on pages 3 and 4)

NOTES



LAR

## LEAD ARSENATE

<b>Common Synonyms</b> Lead arsenate, acid Plumbous arsenate	Solid                      White                      Odorless  Sinks in water.								
<b>AVOID CONTACT WITH SOLID.</b> Keep people away. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.									
<b>Fire</b>	Not flammable								
  <b>Exposure</b>	<b>CALL FOR MEDICAL AID</b> <b>SOLID</b> <b>POISONOUS IF SWALLOWED.</b> If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. If SWALLOWED and victim is UNCONSCIOUS OR HAVING COSEVULSIONS, do nothing except keep victim warm.								
<b>Water Pollution</b>	<b>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.</b> May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.								
<b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook, CG 4-16-4) Issue warning: poison, water contaminant Should be removed chemical and physical treatment	<b>2. LABEL</b> 								
<b>3. CHEMICAL DESIGNATIONS</b> 3.1 <b>Synonyms:</b> Lead arsenate, acid Plumbous arsenate 3.2 <b>Coast Guard Compatibility Classification:</b> Not applicable 3.3 <b>Chemical Formula:</b> PbHAsO <sub>4</sub> 3.4 <b>IMCO/United Nations Numerical Designation:</b> 6.1/1617	<b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 <b>Physical State (as shipped):</b> Solid 4.2 <b>Color:</b> White 4.3 <b>Odor:</b> None								
<b>5. HEALTH HAZARDS</b> 5.1 <b>Personal Protective Equipment:</b> Dust respirator, protective clothing to prevent accidental inhalation or ingestion of dust. 5.2 <b>Symptoms Following Exposure:</b> Inhalation or ingestion causes dizziness, headache, paralysis, cramps, constipation, collapse, coma. Subacute doses cause irritability, loss of weight, anemia, constipation. Blood and urine concentrations of lead increase. 5.3 <b>Treatment for Exposure:</b> A specific medical treatment is used for exposure to this chemical, call a physician immediately! Give victim a tablespoon of salt in glass of warm water and repeat until vomit is clear. Then give two tablespoons of epsom salt or milk of magnesia in water, and plenty of milk and water. Have victim lie down and keep quiet. 5.4 <b>Toxicity by Inhalation (Threshold Limit Value):</b> (dust) 0.15 mg/m <sup>3</sup> 5.5 <b>Short-Term Inhalation Limits:</b> Not pertinent 5.6 <b>Toxicity by Ingestion:</b> Grade 4: LD <sub>50</sub> below 50 mg/kg (rabbit, rat) 5.7 <b>Late Toxicity:</b> Lead poisoning 5.8 <b>Vapor (Gas) Irritant Characteristics:</b> Not pertinent 5.9 <b>Liquid or Solid Irritant Characteristics:</b> None 5.10 <b>Odor Threshold:</b> Not pertinent									
<b>6. FIRE HAZARDS</b> 6.1 <b>Flash Point:</b> Not flammable 6.2 <b>Flammable Limits in Air:</b> Not flammable 6.3 <b>Fire Extinguishing Agents:</b> Not pertinent 6.4 <b>Fire Extinguishing Agents Not to be Used:</b> Not pertinent 6.5 <b>Special Hazards of Combustion Products:</b> Not pertinent 6.6 <b>Behavior in Fire:</b> Not pertinent 6.7 <b>Ignition Temperature:</b> Not flammable 6.8 <b>Electrical Hazard:</b> Not pertinent 6.9 <b>Burning Rate:</b> Not flammable									
<b>7. CHEMICAL REACTIVITY</b> 7.1 <b>Reactivity with Water:</b> No reaction 7.2 <b>Reactivity with Common Materials:</b> No reaction 7.3 <b>Stability During Transport:</b> Stable 7.4 <b>Neutralizing Agents for Acids and Caustics:</b> Not pertinent 7.5 <b>Polymerization:</b> Not pertinent 7.6 <b>Inhibitor of Polymerization:</b> Not pertinent									
<b>8. WATER POLLUTION</b> 8.1 <b>Aquatic Toxicity:</b> 1.4 ppm/48 hr/bluegill/TL <sub>50</sub> /fresh water 8.2 <b>Waterfowl Toxicity:</b> Data not available 8.3 <b>Biological Oxygen Demand (BOD):</b> None 8.4 <b>Food Chain Concentration Potential:</b> Data not available									
<b>9. SELECTED MANUFACTURERS</b> 1. Chempar Chemical Co., Inc. 200 Madison Ave. New York, N. Y. 10016 2. Chevron Chemical Co. Ortha Division 940 Hensley St. Richmond, Calif. 94804 3. I.M.C. Corp. Niagara Chemical Division Middleport, N. Y. 14105									
<b>10. SHIPPING INFORMATION</b> 10.1 <b>Grade or Purity:</b> 94% 10.2 <b>Storage Temperature:</b> Ambient 10.3 <b>Inert Atmosphere:</b> No requirement 10.4 <b>Venting:</b> Open									
<b>11. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook, CG 4-4-3) II									
<b>12. HAZARD CLASSIFICATIONS</b> 12.1 <b>Code of Federal Regulations:</b> Poisonous liquid or solid, Class B 12.2 <b>NAS Hazard Rating for Bulk Water Transportation:</b> Not listed 12.3 <b>NFPA Hazard Classifications:</b> <table> <thead> <tr> <th>Category</th><th>Classification</th></tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td><td>2</td></tr> <tr> <td>Flammability (Red)</td><td>0</td></tr> <tr> <td>Reactivity (Yellow)</td><td>0</td></tr> </tbody> </table>		Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	0	Reactivity (Yellow)	0
Category	Classification								
Health Hazard (Blue)	2								
Flammability (Red)	0								
Reactivity (Yellow)	0								
<b>13. PHYSICAL AND CHEMICAL PROPERTIES</b> 13.1 <b>Physical State at 15°C and 1 atm:</b> Solid 13.2 <b>Molecular Weight:</b> 347.12 13.3 <b>Boiling Point at 1 atm:</b> Decomposes 13.4 <b>Freezing Point:</b> Not pertinent 13.5 <b>Critical Temperature:</b> Not pertinent 13.6 <b>Critical Pressure:</b> Not pertinent 13.7 <b>Specific Gravity:</b> 5.79 at 15°C (solid) 13.8 <b>Liquid Surface Tension:</b> Not pertinent 13.9 <b>Liquid-Water Interfacial Tension:</b> Not pertinent 13.10 <b>Vapor (Gas) Specific Gravity:</b> Not pertinent 13.11 <b>Ratio of Specific Heats of Vapor (Gas):</b> Not pertinent 13.12 <b>Latent Heat of Vaporization:</b> Not pertinent 13.13 <b>Heat of Combustion:</b> Not pertinent 13.14 <b>Heat of Decomposition:</b> Not pertinent 13.15 <b>Heat of Solution:</b> Not pertinent 13.16 <b>Heat of Polymerization:</b> Not pertinent									
<b>NOTES</b> <i>(Continued on pages 5 and 6)</i>									

ATO

## ARSENIC TRIOXIDE

<b>Common Synonyms</b> Arsenous acid Arsenous acid anhydride Arsenous oxide Arsenic sesquioxide White arsenic	<b>Solid crystals or powder</b> <b>White</b> <b>Odorless</b>  Sinks and mixes slowly with water.
<b>AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY.</b> Spr. upward. Use water spray to "knock down" dust. Isolate and remove displaced material. Notify local health and pollution control agencies.	
<b>Fire</b>	Not flammable. <b>POISONOUS GASES MAY BE PRODUCED WHEN HEATED.</b>
  <b>Exposure</b>	<b>CALL FOR MEDICAL AID</b>  <b>DUST</b> <b>POISONOUS IF INHALED.</b> Irritating to eyes, nose and throat. Move victim to fresh air. If in eyes, hold eyelids open and flush with plenty of water. If breathing is difficult, give oxygen.  <b>SOLID</b> <b>POISONOUS IF SWALLOWED.</b> Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If IN EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. If SWALLOWED and victim is UNCONSCIOUS OR HAVING A CON- VULSION, do nothing except keep victim warm.
<b>Water Pollution</b>	<b>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.</b> May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operational nearby water intakes.
<b>1. RESPONSE TO DISCHARGE</b> <small>(See Response Methods Handbook, CG 448-1)</small> Issue warning - poison, water contaminant. Restrict access. Should be removed. Chemical and physical treatment.	<b>2. LABEL</b> 
<b>3. CHEMICAL DESIGNATIONS</b> 3.1 <b>Synonyms:</b> Arsenous acid; Arsenous acid anhydride; Arsenous oxide; Arsenic sesquioxide; White arsenic. 3.2 <b>Coast Guard Compatibility Classification:</b> Not applicable. 3.3 <b>Chemical Formula:</b> As <sub>2</sub> O <sub>3</sub> . 3.4 <b>IMCO/United Nations Numerical Designation:</b> 6.1/1561.	<b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 <b>Physical State (as shipped):</b> Solid. 4.2 <b>Color:</b> White. 4.3 <b>Odor:</b> Like garlic; none.
<b>5. HEALTH HAZARDS</b> 5.1 <b>Personal Protective Equipment:</b> Bureau of Mines approved respirator; protective gloves; eye protection; full protective coveralls. 5.2 <b>Symptoms Following Exposure:</b> Ingestion causes irritation of mucous membrane, weakness, loss of appetite, gastrointestinal disturbances. Overdose can cause arsenic poisoning, but symptoms are delayed. 5.3 <b>Treatment for Exposure:</b> Get medical attention after all exposures to this compound. Be alert for arsenic poisoning symptoms. <b>SKIN:</b> wash thoroughly with soap and water; remove contaminated clothing and shower with soap and water; irritations, except for milder cases which disappear in a day or two, should have medical attention. <b>INGESTION:</b> vomiting should be induced and a physician should be called at once; drink freely of lime water, sweet milk, or raw eggs, followed by castor oil or any brisk cathartic. 5.4 <b>Toxicity by Inhalation (Threshold Limit Value):</b> 0.5 mg/m <sup>3</sup> as arsenic. 5.5 <b>Short-Term Inhalation Limits:</b> Data not available. 5.6 <b>Toxicity by Ingestion:</b> Grade 4; oral mouse LD <sub>50</sub> = 45 mg/kg. 5.7 <b>Late Toxicity:</b> Arsenic compounds may be carcinogenic. 5.8 <b>Vapor (Gas) Irritant Characteristics:</b> Data not available. 5.9 <b>Liquid or Solid Irritant Characteristics:</b> Data not available. 5.10 <b>Odor Threshold:</b> Odorless.	
<b>6. FIRE HAZARDS</b> 6.1 <b>Flash Point:</b> Not flammable. 6.2 <b>Flammable Limits in Air:</b> Not flammable. 6.3 <b>Fire Extinguishing Agents:</b> Not pertinent. 6.4 <b>Fire Extinguishing Agents Not to be Used:</b> Not pertinent. 6.5 <b>Special Hazards of Combustion Products:</b> Toxic fumes of arsenic trioxide and arsenic may be formed in fire situations. 6.6 <b>Behavior in Fire:</b> May volatilize and form toxic fumes of arsenic trioxide. 6.7 <b>Ignition Temperature:</b> Not pertinent. 6.8 <b>Electrical Hazard:</b> Not pertinent. 6.9 <b>Burning Rate:</b> Not pertinent.	
<b>7. CHEMICAL REACTIVITY</b> 7.1 <b>Reactivity with Water:</b> No reaction. 7.2 <b>Reactivity with Common Materials:</b> No reaction. 7.3 <b>Stability During Transport:</b> Stable. 7.4 <b>Neutralizing Agents for Acids and Caustics:</b> Flush with water. 7.5 <b>Polymerization:</b> Not pertinent. 7.6 <b>Inhibitor of Polymerization:</b> Not pertinent.	
<b>8. WATER POLLUTION</b> 8.1 <b>Aquatic Toxicity:</b> 5.3 mg/L / 78 days/salmon/harmful/* (*Type of water not specified) 8.2 <b>Waterfowl Toxicity:</b> Data not available. 8.3 <b>Biological Oxygen Demand (BOD):</b> Data not available. 8.4 <b>Food Chain Concentration Potential:</b> None.	
<b>9. SELECTED MANUFACTURERS</b> 1. American Smelting and Refining Company 120 Broadway New York, N. Y. 10038 2. Gallard-Schlesinger Chemical Manufacturing Co. 584 Mincola Avenue 5 Carle Place, N. Y. 11514 3. Ventron Corp. Alfa Products P. O. Box 159 Beverly, Mass. 01915.	
<b>10. SHIPPING INFORMATION</b> 10.1 <b>Grade or Purity:</b> Refined: 99%; Crude: 95%. 10.2 <b>Storage Temperature:</b> Ambient. 10.3 <b>Inert Atmosphere:</b> No requirement. 10.4 <b>Venting:</b> Pressure-vacuum.	
<b>11. HAZARD ASSESSMENT CODE</b> <small>(See Hazard Assessment Handbook, CG 448-3)</small> H-SS	
<b>12. HAZARD CLASSIFICATIONS</b> 12.1 <b>Code of Federal Regulations:</b> Poisonous, Class B. 12.2 <b>NAS Hazard Rating for Bulk Water Transportation:</b> Not listed. 12.3 <b>MFPA Hazard Classifications:</b> Not listed.	
<b>13. PHYSICAL AND CHEMICAL PROPERTIES</b> 13.1 <b>Physical State at 15°C and 1 atm:</b> Solid. 13.2 <b>Molecular Weight:</b> 197.8. 13.3 <b>Boiling Point at 1 atm:</b> 855°F = 457°C = 730°K. 13.4 <b>Freezing Point:</b> 599°F = 315°C = 588°K. 13.5 <b>Critical Temperature:</b> Not pertinent. 13.6 <b>Critical Pressure:</b> Not pertinent. 13.7 <b>Specific Gravity:</b> 3.7 at 20°C (solid). 13.8 <b>Liquid Surface Tension:</b> Not pertinent. 13.9 <b>Liquid-Water Interfacial Tension:</b> Not pertinent. 13.10 <b>Vapor (Gas) Specific Gravity:</b> Not pertinent. 13.11 <b>Ratio of Specific Heats of Vapor (Gas):</b> Not pertinent. 13.12 <b>Latent Heat of Vaporization:</b> Not pertinent. 13.13 <b>Heat of Combustion:</b> Not pertinent. 13.14 <b>Heat of Decomposition:</b> Not pertinent. 13.15 <b>Heat of Solution:</b> Data not available. 13.16 <b>Heat of Polymerization:</b> Not pertinent.	
<b>NOTES</b>	

(Continued on pages 3 and 4)



## CALCIUM FLUORIDE

### ✓ CALCIUM FLUORIDE

#### General Information

Cubic, colorless crystals; luminous with heat.

Formula:  $\text{CaF}_2$ .

Mol wt: 78.1, mp: 1360°C, d: 3.180.

#### Hazard Analysis

See fluorides.

#### Countermeasures

See fluorides.

### ✓ FLUORIDES \*

#### Hazard Analysis

##### Toxic Hazard Rating:

Acute Local: Irritant 3.

Acute Systemic: Ingestion 3; Inhalation 3.

Chronic Local: Irritant 1.

Chronic Systemic: Ingestion 3; Inhalation 3.

Toxicology: Inorganic fluorides are generally highly irritant and toxic. Acute effects resulting from exposure to fluorine compounds are due to hydrogen fluoride. Chronic fluorine poisoning, or "fluorosis," occurs among miners of cryolite, and consists of a sclerosis of the bones, caused by fixation of the calcium by the fluorine. There may also be some calcification of the ligaments. The teeth are mottled, and there is osteosclerosis and osteomalacia. The bony and ligamentous changes are demonstrable by x-ray. Estimated LD (man) = 2.5 g.

Loss of weight, anorexia, anemia, wasting and cachexia, and dental defects are among the common findings in chronic fluorine poisoning. There may be an eosinophilia, and impairment of growth in young workers. Symptoms of intoxication include gastric, intestinal, circulatory, respiratory and nervous complaints and skin rashes.

Organic fluorides are generally less toxic than other halogenated hydrocarbons.

Common air contaminants.

Disaster Hazard: Dangerous; when heated to decomposition or on contact with acid or acid fumes, they emit highly toxic fumes.

#### Countermeasures

Ventilation Control: Section 2.

Personnel Protection: Section 2.

Storage and Handling: Section 7.

CAF

## CALCIUM FLUORIDE

Common Synonyms: Fluorapatite		Solid powder or granules	Gray	Odorless
Sinks in water.				
Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		Not flammable.		
Exposure		CALL FOR MEDICAL AID SOLID Harmful if swallowed. Not irritating to skin or eyes. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.		
Water Pollution		Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and pollution control officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook, CG 448-4) Disperse and flush.		2. LABELS No hazard label required by Code of Federal Regulations		
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Fluorapatite Fluorapatite 3.2 Coast Guard Compatibility Classification: Not applicable 3.3 Chemical Formula: $\text{CaF}_2$ 3.4 IMCO/United Nations Numerical Designation: Not listed		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: Gray 4.3 Odor: Odorless		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: For dust only 5.2 Symptoms Following Exposure: Little acute toxicity 5.3 Treatment for Exposure: Usually no treatment needed 5.4 Toxicity by Inhalation (Threshold Limit Value): Not pertinent 5.5 Short-Term Inhalation Limits: Not pertinent 5.6 Toxicity by Ingestion: Grade 2; LD <sub>50</sub> 0.5 to 5 g/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Not pertinent 5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard. Practically harmless to the skin. 5.10 Odor Threshold: Not pertinent				
6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Not flammable 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not flammable				
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent				
8. WATER POLLUTION 8.1 Aquatic Toxicity: 30000 ppm/* (inca vulgaris/lethal/fresh water *Time period not specified 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Not pertinent 8.4 Food Chain Concentration Potential: Not pertinent				
9. SELECTED MANUFACTURERS 1. Allied Chemical Corp. Specialty Chemicals Div. Marcus Hook, Pa. 19961 2. Combustion Engineering Inc. C.E. Minerals Div. 443 South Gulph Rd. King of Prussia, Pa. 19406 3. Ozark-Mahoning Co. Tulsa, Oklahoma 74119				
10. SHIPPING INFORMATION 10.1 Grades or Purities: Acid grade: 97.4%; Ceramic grade: 91.5%; Fine powder (dry or damp cake); Gravel fluorspar; Pellet 10.2 Storage Temperature: Data not available 10.3 Inert Atmosphere: Data not available 10.4 Venting: Data not available				
11. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook, CG 448-3) II		13. PHYSICAL AND CHEMICAL PROPERTIES 13.1 Physical State at 15°C and 1 atm: Solid 13.2 Molecular Weight: 78.08 13.3 Boiling Point at 1 atm: Not pertinent 13.4 Freezing Point: Not pertinent 13.5 Critical Temperature: Not pertinent 13.6 Critical Pressure: Not pertinent 13.7 Specific Gravity: 3.18 at 20°C (solid) 13.8 Liquid Surface Tension: Not pertinent 13.9 Liquid-Water Interfacial Tension: Not pertinent 13.10 Vapor (Gas) Specific Gravity: Not pertinent 13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 13.12 Latent Heat of Vaporization: Not pertinent 13.13 Heat of Combustion: Not pertinent 13.14 Heat of Decomposition: Not pertinent 13.15 Heat of Solution: Not pertinent 13.16 Heat of Polymerization: Not pertinent		
12. HAZARD CLASSIFICATIONS 12.1 Code of Federal Regulations: Not listed 12.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 12.3 NFPA Hazard Classifications: Not listed				
NOTES				

(Continued on pages 1 and 6)

## CALCIUM HYDROXIDE

### CALCIUM HYDROXIDE

#### General Information

Synonyms: hydrate lime; slaked lime.

Rhombic, trigonal, colorless crystals.

Formula:  $\text{Ca}(\text{OH})_2$ .

Mol wt: 74.10, mp:  $-\text{H}_2\text{O}$  at  $580^\circ\text{C}$ , bp: decomposes, d: 2.343.

#### Hazard Analysis

Toxicity: A general purpose food additive, also a substance migrating to food from packaging materials (Section 10). See calcium compounds.

Toxicology: Calcium hydroxide has a caustic reaction and therefore is irritating to the skin and respiratory system. In the form of dust it is considered to be an important industrial hazard. It can cause dermatitis, irritation of the eyes and mucous membranes (Section 9). It is a common air contaminant.

#### Countermeasures

Treatment and Antidotes: Irrigate any areas which have come in contact with this material. If the eyes are involved, they should be washed at once with copious amounts of warm water. If the skin is involved, a shower is recommended. See also calcium compounds.

Ventilation Control: Section 2.

Personal Hygiene: Section 2.

<div>Common Synonyms Slaked lime</div>		Solid granules	White	Odorless
		Sinks in water.		
Avoid contact with solid and dust. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Isolate and remove discolored material. Notify local health and pollution control agencies.				
Fire		Not flammable.		
Exposure		CALL FOR MEDICAL AID. DUST Irritating to nose and throat if inhaled. Move to fresh air. SOLID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.		
Water Pollution		HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE <small>(See Response Methods Handbook, CG 446-1)</small> Disperse and flush.		2. LABELS  No hazard label required by Code of Federal Regulations.		
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Slaked lime 3.2 Coast Guard Compatibility Classification: Not applicable 3.3 Chemical Formula: Ca(OH) <sub>2</sub> 3.4 IMCO, United Nations Numerical Designation: Not listed		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: White 4.3 Odor: None		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Dust-proof goggles and mask 5.2 Symptoms Following Exposure: Dust irritates eyes, nose, and throat 5.3 Treatment for Exposure: INGESTION: have victim drink milk and water. Do NOT induce vomiting. EYES: flush with a gentle stream of water for at least 10 min. and consult an ophthalmologist for further treatment without delay. SKIN: wash off the lime and consult a physician. 5.4 Toxicity by Inhalation (Threshold Limit Value): Not pertinent 5.5 Short-Term Inhalation Limits: Not pertinent 5.6 Toxicity by Ingestion: Grade I: 1.0 to 15 g/kg (rat) 5.7 Late Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Not pertinent 5.9 Liquid or Solid Irritant Characteristics: None 5.10 Odor Threshold: Not pertinent				
6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Not flammable 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not flammable				
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent				
8. WATER POLLUTION 8.1 Aquatic Toxicity: 92 ppm/7 hr/trout/fresh water 240 ppm/24 hr/mosquito fish/1 Lm/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None				
9. SELECTED MANUFACTURERS 1. Ash Grove Cement Co. 1000 Ten Main Center Kansas City, Mo. 64105 2. Engelhard Minerals & Chemical Corp. Minerals and Chemicals Division Menlo Park, N. J. 08617 3. United States Gypsum Co. Chemicals Division Chicago, Ill. 60696				
10. SHIPPING INFORMATION 10.1 Grades or Purities: Agricultural: 65-71%; Industrial: 70-73%; chemical: 71-73% 10.2 Storage Temperature: Data not available 10.3 Inert Atmosphere: Data not available 10.4 Venting: Data not available				
11. HAZARD ASSESSMENT CODE <small>(See Hazard Assessment Handbook, CG 446-3)</small> 11				
12. HAZARD CLASSIFICATIONS 12.1 Code of Federal Regulations: Not listed 12.2 HAS Hazard Rating for Bulk Water Transportation: Not listed 12.3 NFPA Hazard Classifications: Not listed				
13. PHYSICAL AND CHEMICAL PROPERTIES 13.1 Physical State at 15°C and 1 atm: Solid 13.2 Molecular Weight: 74.09 13.3 Boiling Point at 1 atm: Not pertinent 13.4 Freezing Point: Not pertinent 13.5 Critical Temperature: Not pertinent 13.6 Critical Pressure: Not pertinent 13.7 Specific Gravity: 2.24 at 20°C (solid) 13.8 Liquid Surface Tension: Not pertinent 13.9 Liquid-Water Interfacial Tension: Not pertinent 13.10 Vapor (Gas) Specific Gravity: Not pertinent 13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 13.12 Latent Heat of Vaporization: Not pertinent 13.13 Heat of Combustion: Not pertinent 13.14 Heat of Decomposition: Not pertinent 13.15 Heat of Solution: Not pertinent 13.16 Heat of Polymerization: Not pertinent				
(Continued on pages 3 and 4)				
NOTES				

## CALCIUM SULFATE

### CALCIUM SULFATE

#### General Information

(Pure anhydrous): White powder or crystals; odorless.

Formula:  $\text{CaSO}_4$

Mol wt: 136, d: 2.964, mp: 1450°C.

#### Hazard Analysis

Toxic Hazard Rating: U. A nutrient and/or dietary supplement food additive (Section 10).

Disaster Hazard: Dangerous. See sulfates.

### SULFATES

#### Hazard Analysis

Toxicity: Variable. In general the toxic qualities of substances containing the sulfate radical is that of the material (cation) with which the sulfate (anion) is combined. See specific compound.

Disaster Hazard: Dangerous. When heated to decomposition, they emit highly toxic fumes of  $\text{SO}_4$ .

### CALCIUM COMPOUNDS

#### Hazard Analysis

Toxic Hazard Rating:

Acute Local: Irritant 1; Ingestion 1; Inhalation 1.

Acute Systemic: U.

Chronic Local: Irritant 1.

Chronic Systemic: U.

Toxicology: The fumes evolved by burning calcium in air are composed of calcium oxide (quick lime). This material is irritating to the skin, eyes and mucous membranes. Many calcium compounds are used medicinally. Generally speaking, calcium compounds should be considered toxic only when they contain a toxic component (such as arsenic, etc.) or as calcium oxide or hydroxide. Calcium compounds are common air contaminants.

#### Countermeasures

Treatment and Antidotes: Any calcium residue left on the body or clothing should be brushed off immediately.

## CHLOROBENZENE (MEANT TO APPLY TO FAMILY)

### ✓ CHLOROBENZENE \*

#### General Information

Synonyms: phenyl chloride; monochlorobenzene; chlorobenzol.

Clear, colorless liquid.

Formula:  $C_6H_5Cl$ .

Mol wt: 112.56, bp: 131.7°C, lcl = 1.3%, ucl = 7.1% at 150°C, mp: -45°C, flash p.: 85°F (C.C.), d: 1.113 at 15.5°/15.5°C, autoign. temp.: 1180° F, vap. press.: 10 mm at 22.2°C, vap. d.: 3.88.

#### Hazard Analysis

Toxic Hazard Rating:

Acute Local: Irritant 1; Ingestion 1; Inhalation 1.

Acute Systemic: Ingestion 2; Inhalation 2; Skin Absorption 1.

Chronic Local: 0.

Chronic Systemic: Ingestion 2; Inhalation 2; Skin Absorption 2.

Toxicology: Monochlorobenzol is a fairly strong narcotic and possesses only slight irritant qualities. For cats, concentrations of 1,200 ppm are quite narcotic, and concentrations of 3,700 ppm are fatal after several hours. The dichlorobenzols are strongly narcotic, 1,000 ppm causing narcosis in guinea pigs followed by death after 20 hours exposure. Knowledge of the effects on man of repeated exposure to subnarcotic concentrations is meager. In general, it appears that the chlorobenzols are not as toxic as benzol. Some of the symptoms described (methemoglobinemia) suggest that other substances, such as nitrobenzol, may have been partially responsible for the few cases of industrial illness reported. It is possible that prolonged exposure to chlorobenzol may cause kidney and liver damage.

Somnolence, loss of consciousness, twitchings of the extremities, cyanosis, deep, rapid respirations and a small, irregular pulse are the chief symptoms occurring in acute exposures. The urine may be burgundy red, and the red blood cells show degenerative and regenerative changes.

Fire Hazard: Dangerous, when exposed to heat or flame.

Spontaneous Heating: No.

Explosion Hazard: Moderate, when exposed to heat or flame.

Disaster Hazard: Dangerous; see chlorine compounds; can react vigorously with oxidizing materials.

#### Countermeasures

Ventilation Control: Section 2.

To Fight Fire: Foam, carbon dioxide, dry chemical or carbon tetrachloride (Section 7).

## CHLOROBENZENE

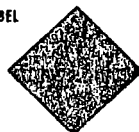
<b>Common Synonyms</b> Monochlorobenzene Phenyl chloride Benzene chloride	<b>Wettable Liquid</b>	<b>Colorless</b>	<b>Sweet, almond odor</b>
Sinks in water. Flammable vapor is produced.  Avoid contact with liquid and vapor. Keep people away. Stop discharge if possible. Call fire department. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.			
<b>Fire</b>	<b>FLAMMABLE</b> Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.  Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide.		
<b>Exposure</b>	<b>CALL FOR MEDICAL AID.</b> <b>VAPOR</b> If inhaled, will cause coughing or dizziness. Not irritating to eyes, nose and throat. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.  <b>LIQUID</b> Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.		
<b>Water Pollution</b>	<b>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.</b> May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook, CG 446-14.)

Should be removed.  
Chemical and physical treatment.

## 2. LABEL



## 3. CHEMICAL DESIGNATIONS

- 3.1 **Synonyms:**  
Benzene chloride  
MCB  
Monochlorobenzene  
Phenyl chloride
- 3.2 **Coast Guard Competibility Classification:**  
Halogenated hydrocarbon
- 3.3 **Chemical Formula:**  $C_6H_5Cl$
- 3.4 **IMCO/United Nations Numerical Designation:** 3.3/1134

## 4. OBSERVABLE CHARACTERISTICS

- 4.1 **Physical State (as shipped):** Liquid
- 4.2 **Color:** Colorless
- 4.3 **Odor:** Mild amine odor; sweet, almond like, aromatic

## 5. HEALTH HAZARDS

- 5.1 **Personal Protective Equipment:** Organic vapor acid gas respirator where appropriate; neoprene or vinyl gloves, chemical safety spectacles, plus face shield where appropriate; rubber footwear; apron or impervious clothing for splash protection; hard hat
- 5.2 **Symptoms Following Exposure:** Irritating to skin, eyes and mucous membranes. Repeated exposure of skin may cause dermatitis due to detaching action. Chronic inhalation of vapors or mist may result in damage to lungs, liver, and kidneys. Acute vapor exposures can cause symptoms ranging from coughing to transient anesthesia and central nervous system depression.
- 5.3 **Treatment for Exposure:** Get medical attention for all eye exposures and any serious over-exposures. Treat the symptoms. **INHALATION:** remove to clean air, administer oxygen as needed. **INGESTION:** dilute by drinking water, if vomiting occurs, administer more water. Administer saline laxative. **EYES:** flush thoroughly with water. **SKIN:** remove contaminated clothing, wash exposed area with soap and water.
- 5.4 **Toxicity by Inhalation (Threshold Limit Value):** 75 ppm
- 5.5 **Short-Term Inhalation Limits:** Data not available
- 5.6 **Toxicity by Ingestion:** Grade 2: LD<sub>50</sub> 0.5 to 5 g/kg (rat, rabbit)
- 5.7 **Late Toxicity:** Data not available
- 5.8 **Vapor (Gas) Irritant Characteristics:** Vapors are nonirritating to the eyes and throat.
- 5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
- 5.10 **Odor Threshold:** 0.21 ppm

## 6. FIRE HAZARDS

- 6.1 **Flash Point:** 84°F (C), 97°F (C)
- 6.2 **Flammable Limits in Air:**  
1.0% - 7.1%
- 6.3 **Fire Extinguishing Agents:**  
Carbon dioxide, dry chemical, foam or water spray
- 6.4 **Fire Extinguishing Agents Not to be Used:**  
Not pertinent
- 6.5 **Special Hazards of Combustion Products:**  
Burning in open flame can form toxic phosphene and hydrogen chloride gases
- 6.6 **Behavior in Fire:** Heavy vapor can travel a considerable distance to a source of ignition and flash back.
- 6.7 **Ignition Temperature:** 1184°F
- 6.8 **Electrical Hazard:** Data not available
- 6.9 **Burning Rate:** test: 3.4-6 mm/min.

## 7. CHEMICAL REACTIVITY

- 7.1 **Reactivity with Water:** No reaction
- 7.2 **Reactivity with Common Materials:**  
No reaction
- 7.3 **Stability During Transport:** Stable
- 7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
- 7.5 **Polymerization:** Not pertinent
- 7.6 **Inhibitor of Polymerization:**  
Not pertinent

## 8. WATER POLLUTION

- 8.1 **Aquatic Toxicity:**  
20 ppm/96 hr/bluegill/11-day/fresh water
- 8.2 **Waterfowl Toxicity:** Data not available
- 8.3 **Biological Oxygen Demand (BOD):**  
0.3 lb/lb, 5 days
- 8.4 **Food Chain Concentration Potential:**  
Data not available

## 9. SELECTED MANUFACTURERS

- Dow Chemical Co.  
Midland, Mich. 48640
- Monsanto Co.  
Monsanto Industrial Chemicals Co.,  
800 North Lindbergh Blvd.  
St. Louis, Mo. 63166
- Montrose Chemical Corp.  
500 South Virgil Ave.  
Los Angeles, Calif. 90005

## 10. SHIPPING INFORMATION

- 10.1 **Grade or Purity:** 99.5%; technical
- 10.2 **Storage Temperature:** Ambient
- 10.3 **Inert Atmosphere:** No requirement
- 10.4 **Venting:** Pressure-vacuum

## 11. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook, CG 446-7.)

A 1-X

## 12. HAZARD CLASSIFICATIONS

- 12.1 **Code of Federal Regulations:**  
Flammable Liquid
- 12.2 **NAB Hazard Rating for Bulk Water Transportation:**
- | Category                 | Rating |
|--------------------------|--------|
| Fire                     | 3      |
| Health                   |        |
| Vapor Irritant           | 0      |
| Liquid or Solid Irritant | 1      |
| Poison                   | 2      |
| Water Pollution          |        |
| Human Toxicity           | 1      |
| Aquatic Toxicity         | 3      |
| Aesthetic Effect         | 2      |
| Reactivity               |        |
| Other Chemicals          | 1      |
| Water                    | 0      |
| Self-Reaction            | 0      |
- 12.3 **NFPA Hazard Classifications:**
- | Category             | Classification |
|----------------------|----------------|
| Health Hazard (Blue) | 2              |
| Flammability (Red)   | 3              |
| Reactivity (Yellow)  | 0              |

## 13. PHYSICAL AND CHEMICAL PROPERTIES

- 13.1 **Physical State at 15°C and 1 atm:** Liquid
- 13.2 **Molecular Weight:** 112.56
- 13.3 **Boiling Point at 1 atm:**  
270°F = 132°C = 405°K
- 13.4 **Freezing Point:**  
-50.1°F = -45.6°C = 227.6°K
- 13.5 **Critical Temperature:**  
678°F = 359°C = 632°K
- 13.6 **Critical Pressure:**  
656 psia = 44.6 atm = 4.52 MN/m<sup>2</sup>
- 13.7 **Specific Gravity:** 1.11 at 20°C (liquid)
- 13.8 **Liquid Surface Tension:**  
33 dynes/cm = 0.033 N/m at 25°C
- 13.9 **Liquid-Water Interfacial Tension:**  
37.4 dynes/cm = 0.0374 N/m at 20°C
- 13.10 **Vapor (Gas) Specific Gravity:**  
Not pertinent
- 13.11 **Ratio of Specific Heats of Vapor (Gas):**  
1.054
- 13.12 **Latent Heat of Vaporization:**  
135 Btu/lb = 75 cal/g = 3.140 x 10<sup>3</sup> J/kg
- 13.13 **Heat of Combustion:** (est.) 12,000 Btu/lb = 6700 cal/g = 280 x 10<sup>3</sup> J/kg
- 13.14 **Heat of Decomposition:** Not pertinent
- 13.15 **Heat of Solution:** Not pertinent
- 13.16 **Heat of Polymerization:** Not pertinent

(Continued on pages 5 and 6)

NOTES

## SODIUM HYDROXIDE

### **SODIUM HYDROXIDE \***

#### **General Information**

Synonyms: caustic soda; sodium hydrate; lye; white caustic.

White, deliquescent pieces, lumps or sticks.

Formula: NaOH.

Mol wt: 40.01, mp: 318.4°C, bp: 1390°C, d: 2.120 at 20°/4°C, vap. press.: 1 mm at 739°C.

#### **Hazard Analysis**

##### **Toxic Hazard Rating:**

Acute Local: Irritant 3; Ingestion 3; Inhalation 2.

Acute Systemic: U.

Chronic Local: Irritant 2.

Chronic Systemic: U.

**Toxicology:** This material, both solid and in solution, has a markedly corrosive action upon all body tissue. The symptoms of irritation from this material are frequently evident immediately. Its corrosive action on tissue causes burns and frequently deep ulceration, with ultimate scarring. Prolonged contact with dilute solutions has a destructive effect upon tissue. Mists, vapors, and dusts of this compound cause small burns, and contact with the eyes, either in the solid or solution form, rapidly causes severe damage to the delicate tissue. Ingestion either in the solid or solution form causes very serious damage to the mucous membranes or other tissues with which contact is made. It can cause perforation and scarring. Inhalation of the dust or concentrated mist can cause damage to the upper respiratory tract and to lung tissue, depending upon the severity of the exposure. Thus, effects of inhalation may vary from mild irritation of the mucous membranes to a severe pneumonitis. It can cause an irritant dermatitis (Section 9). It is a general purpose food additive; it migrates to food from packaging materials (Section 10).

**Disaster Hazard:** Dangerous; will react with water or steam to produce heat and will attack living tissue.

#### **Countermeasures**

**Ventilation Control:** Section 2.

**Treatment and Antidotes:** Speed in removing this caustic from contact with the skin of one who has come in contact with it is important to avoid injury. Remove all contaminated clothing at once and if possible give patient a shower under deluge type of shower using plenty of water. If the eyes are involved, they should be irrigated at once with plenty of warm water for 15 minutes. Persons so injured should be referred to a physician.

**Personnel Protection:** Section 2.

**Storage and Handling:** Section 7.


**Shipping Regulations:** Section 11.

Regulated by CG, DOT, IATA.



SHD

## SODIUM HYDROXIDE

<b>Common Synonyms</b> Caustic soda Lye	<b>Solid flakes or pellets</b> <b>White</b> <b>Odorless</b>  Sinks and mixes with water.
Avoid contact with solid and dust. Keep people away. Wear rubber overclothing including gloves. Stop discharge if possible. Isolate and remove discharge material. Notify local health and pollution control agencies.	
<b>Fire</b>	Not flammable. May cause fire on contact with combustibles. Flammable gas may be produced on contact with metals. Wear rubber overclothing including gloves. Flood discharge area with water. Flood exposed containers with water.
<b>Exposure</b>	<b>CALL FOR MEDICAL AID</b> <b>DUST</b> Irritating to eyes, nose and throat. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. <b>IF IN EYES:</b> hold eyelids open and flush with plenty of water. <b>SOLID</b> Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. <b>IF IN EYES:</b> hold eyelids open and flush with plenty of water. <b>IF SWALLOWED:</b> and victim is CONSCIOUS, have victim drink water or milk. <b>DO NOT INDUCE VOMITING.</b>
<b>Water Pollution</b>	Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify supervisors of nearby water intakes.
<b>1. RESPONSE TO DISCHARGE</b> <small>(See Response Methods Handbook, CG 440-4)</small> Issue warning: <b>corrosive</b> Restrict access. Disperse and flush.	
<b>3. CHEMICAL DESIGNATIONS</b> 3.1 <b>Synonyms:</b> Caustic soda 3.2 <b>Coast Guard Compatibility Classification:</b> Not applicable 3.3 <b>Chemical Formula:</b> NaOH 3.4 <b>IMCO/United Nations Numerical Designation:</b> 8.0/1X2.1	<b>2. LABEL</b>   <b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 <b>Physical State (as shipped):</b> Solid 4.2 <b>Color:</b> White 4.3 <b>Odor:</b> Odorless
<b>5. HEALTH HAZARDS</b> 5.1 <b>Personal Protective Equipment:</b> Chemical safety goggles, face shield, filter or dust-type respirator; rubber boots, rubber gloves. 5.2 <b>Symptoms Following Exposure:</b> Strong corrosive action on contacted tissues. <b>INHALATION:</b> dust may cause damage to upper respiratory tract and lung itself, producing from mild nose irritation to pneumonitis. <b>INGESTION:</b> severe damage to mucous membranes; severe scar formation or perforation may occur. <b>EYE CONTACT:</b> produces severe damage. 5.3 <b>Treatment for Exposure:</b> <b>INHALATION:</b> remove from exposure, support respiration; call physician. <b>INGESTION:</b> give water or milk followed by dilute vinegar or fruit juice, do NOT induce vomiting. <b>SKIN:</b> wash immediately with large quantities of water under emergency safety shower while removing clothing; continue washing until medical help arrives; call physician. <b>EYES:</b> irrigate immediately with copious amounts of water for at least 15 min; call physician. 5.4 <b>Toxicity by Inhalation (Threshold Limit Value):</b> Not pertinent 5.5 <b>Short-Term Inhalation Limits:</b> Not pertinent 5.6 <b>Toxicity by Ingestion: (10% solution) oral rabbit LD<sub>50</sub> = 500 mg/kg</b> 5.7 <b>Leto Toxicity:</b> None 5.8 <b>Vapor (Gas) Irritant Characteristics:</b> Non-volatile 5.9 <b>Liquid or Solid Irritant Characteristics:</b> Severe skin irritant. Causes second- and third degree burns on short contact and is very injurious to the eyes. 5.10 <b>Odor Threshold:</b> Not pertinent	

<b>6. FIRE HAZARDS</b> 6.1 <b>Flash Point:</b> Not flammable 6.2 <b>Flammable Limits in Air:</b> Not flammable 6.3 <b>Fire Extinguishing Agents:</b> Not pertinent 6.4 <b>Fire Extinguishing Agents Not to be Used:</b> Not pertinent 6.5 <b>Special Hazards of Combustion Products:</b> Not pertinent 6.6 <b>Behavior in Fire:</b> Not pertinent 6.7 <b>Ignition Temperature:</b> Not flammable 6.8 <b>Electrical Hazard:</b> Not pertinent 6.9 <b>Burning Rate:</b> Not flammable	<b>8. WATER POLLUTION</b> 8.1 <b>Aquatic Toxicity:</b> 125 ppm/96 hr mosquitofish/TL <sub>50</sub> fresh water 180 ppm/24 hr mysids/lethal/salt water 8.2 <b>Waterfowl Toxicity:</b> Data not available 8.3 <b>Biological Oxygen Demand (BOD):</b> None 8.4 <b>Food Chain Concentration Potential:</b> None								
<b>7. CHEMICAL REACTIVITY</b> 7.1 <b>Reactivity with Water:</b> Dissolves with liberation of much heat, may steam and splatter. 7.2 <b>Reactivity with Common Materials:</b> When wet, attacks metals such as aluminum, tin, lead, and zinc to produce flammable hydrogen gas. 7.3 <b>Stability During Transport:</b> Stable 7.4 <b>Neutralizing Agents for Acids and Caustics:</b> Flush with water, mix with dilute acetic acid. 7.5 <b>Polymerization:</b> Not pertinent 7.6 <b>Inhibitor of Polymerization:</b> Not pertinent	<b>9. SELECTED MANUFACTURERS</b> 1. Diamond Shamrock Corp. Electro Chemicals Division Deer Park, Tex. 77536 2. Dow Chemical Co. Midland, Mich. 48660 3. PPG Industries, Inc. Industrial Chemical Division Barberton, Ohio 44203								
<b>10. SHIPPING INFORMATION</b> 10.1 <b>Grades or Purity:</b> Technical flakes, USP pellets 10.2 <b>Storage Temperature:</b> Ambient 10.3 <b>Inert Atmosphere:</b> No requirement 10.4 <b>Venting:</b> Open									
<b>11. HAZARD ASSESSMENT CODE</b> <small>(See Hazard Assessment Handbook, CG 440-3)</small> SS	<b>13. PHYSICAL AND CHEMICAL PROPERTIES</b> 13.1 <b>Physical State at 15°C and 1 atm:</b> Solid 13.2 <b>Molecular Weight:</b> 40.00 13.3 <b>Boiling Point at 1 atm:</b> Very high 13.4 <b>Freezing Point:</b> 604°F = 318°C = 391°K 13.5 <b>Critical Temperature:</b> Not pertinent 13.6 <b>Critical Pressure:</b> Not pertinent 13.7 <b>Specific Gravity:</b> 2.13 at 20°C (solid) 13.8 <b>Liquid Surface Tension:</b> Not pertinent 13.9 <b>Liquid-Water Interfacial Tension:</b> Not pertinent 13.10 <b>Vapor (Gas) Specific Gravity:</b> Not pertinent 13.11 <b>Ratio of Specific Heats of Vapor (Gas):</b> Not pertinent 13.12 <b>Latent Heat of Vaporization:</b> Not pertinent 13.13 <b>Heat of Combustion:</b> Not pertinent 13.14 <b>Heat of Decomposition:</b> Not pertinent 13.15 <b>Heat of Solution:</b> Not pertinent 13.16 <b>Heat of Polymerization:</b> Not pertinent								
<b>12. HAZARD CLASSIFICATIONS</b> 12.1 <b>Code of Federal Regulations:</b> Corrosive Material 12.2 <b>NAB Hazard Rating for Bulk Water Transportation:</b> Not listed 12.3 <b>NFPA Hazard Classifications:</b> <table data-bbox="874 1434 1137 1518"> <thead> <tr> <th>Category</th><th>Classification</th></tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td><td>3</td></tr> <tr> <td>Flammability (Red)</td><td>0</td></tr> <tr> <td>Reactivity (Yellow)</td><td>1</td></tr> </tbody> </table>		Category	Classification	Health Hazard (Blue)	3	Flammability (Red)	0	Reactivity (Yellow)	1
Category	Classification								
Health Hazard (Blue)	3								
Flammability (Red)	0								
Reactivity (Yellow)	1								
NOTES									

REVISED 1978

## SODIUM SILICATE AND SILICA GEL

### SODIUM SILICATE

#### General Information

Synonym: Water glass.

Amorphous or colorless, deliquescent crystals.

Formula:  $\text{Na}_2\text{O} \cdot x\text{SiO}_2$ .

#### Hazard Analysis

Toxicity: A caustic material, irritating to skin and mucous membranes. Ingestion causes GI upset.

A substance which migrates to food from packaging materials (Section 10).

#### Countermeasures

Personal Hygiene: Section 2.

### SILICA \*

#### General Information

Synonyms: silicon dioxide; silicic anhydride; cristobalite.

Colorless crystals.

Formula:  $\text{SiO}_2$ .

Mol wt: 60.09; mp: 1710°C; bp: 2230°C; d: amorphous 2.2, crystalline 2.6; vap. press.: 10 mm at 1732°C.

#### Hazard Analysis

Toxic Hazard Rating:

Acute Local: Inhalation 2.

Acute Systemic: 0.

Chronic Local: Inhalation 3.

Chronic Systemic: Inhalation 1.

Toxicology: From the point of view of numbers of men exposed and cases of disability produced, silica is the chief cause of pulmonary dust disease. The prolonged inhalation of dusts containing free silica may result in the development of a disabling pulmonary fibrosis known as silicosis. The Committee on Pneumoconiosis of the American Public Health Association defines silicosis as "a disease due to the breathing of air containing silica ( $\text{SiO}_2$ ), characterized by generalized fibrotic changes and the development of miliary nodules in both lungs, and clinically by shortness of breath, decreased chest expansion, lessened capacity for work, absence of fever, increased susceptibility to tuberculosis (some or all of which symptoms may be present), and characteristic x-ray findings."

Silica occurs in the pure state in nature as quartz. It is the main constituent of sand, sandstone, tripoli and diatomaceous earth, and is present in high amounts (up to 35%) in granite. Exposure to silica occurs in hard rock mining, in foundries, in manufacture of porcelain and pottery, in the spraying of vitreous enamels, in sandblasting, in granite-cutting and tombstone-making, in the manufacture of silica firebrick and other refractories, in grinding and polishing operations where natural abrasive wheels are used and other occupations.

The duration of exposure which is associated

with the development of silicosis varies widely for different occupations. Thus, the average duration of exposure required for the development of silicosis in sand-blasters is 2 to 10 years, in moulders and granite cutters, about 30 years, and in hard rock miners 10 to 15 years. There is, also, much variation in individual susceptibility, certain workers showing radiological evidence of the disease years before their fellow workmen who are similarly exposed. Such susceptible individuals are fortunately rather rare.

The action of silica on the lungs results in the production of a diffuse, nodular fibrosis in which the parenchyma and the lymphatic system are involved. This fibrosis is, to a certain extent, progressive, and may continue to increase for several years after exposure is terminated. Where the pulmonary reserve is sufficiently reduced, the worker complains of shortness of breath on exertion. This is the first and most common symptom in cases of uncomplicated silicosis. If severe, it may incapacitate the worker for heavy, or even light, physical exertion, and in extreme cases there may be shortness of breath even while at rest. The most common physical sign of silicosis is a limitation of expansion of the chest. There may be a dry cough, sometimes very troublesome. The characteristic radiographic appearance is one of diffuse, discrete nodulation, scattered throughout both lung fields. Where the disease advances, the shortness of breath becomes worse, and the cough more productive and troublesome. There is no fever or other evidence of systematic reaction. Further progress of the disease results in marked fatigue, extreme dyspnea and cyanosis, loss of appetite, pleuritic pain and total incapacity to work. If tuberculosis does not supervene, the condition may eventually cause death either from cardiac failure or from destruction of lung tissue, with resultant anoxemia. In the later stages, the x-ray may show large conglomerate shadows, due to the coalescence of the silicotic nodules, with areas of emphysema between them.

Silica is used as a food additive permitted in the feed and drinking water of animals and/or for the treatment of food producing animals. It is also permitted in food for human consumption (Section 10). It is a common air contaminant.

#### Countermeasures

Ventilation Control: Section 2.

### SILICA AEROGEL

#### General Information

A finely powdered microcellular silica foam having a minimum silica content of 89.5%.

#### Hazard Analysis

Toxicity: Unknown. A general purpose food additive (Section 10). See also silica.

### SILICA GEL

#### General Information

Synonym: silicic acid (precipitated).

White powder or lustrous granules.

Formula:  $\text{H}_2\text{SiO}_4$ .

Mol wt: 78.1.

Toxicity: Slight. See silica.

#### TOXIC HAZARD RATING CODE (For detailed discussion, see Section 9.)

0 NONE: (a) No harm under any conditions; (b) Harmful only under unusual conditions or overwhelming dosage.

1 SLIGHT: Causes readily reversible changes which disappear after end of exposure.

2 MODERATE: May involve both irreversible and revers-

ible changes not severe enough to cause death or permanent injury.

3 HIGH: May cause death or permanent injury after very short exposure to small quantities.

U UNKNOWN: No information on humans considered valid by authors.

SSC

## SODIUM SILICATE

<b>Common Synonyms</b> Water glass Soluble glass		Thick liquid Colorless Odorless Sinks and mixes with water
Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.		
<b>Fire</b>	Not flammable.	
<b>Exposure</b>	<b>CALL FOR MEDICAL AID</b> <b>LIQUID</b> Harmful if swallowed. IF SWALLOWED: Do not induce VOMITING. Have person drink water or milk. DO NOT INDUCE VOMITING.	
<b>Water Pollution</b>	Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
<b>1. RESPONSE TO DISCHARGE</b> <small>(See Response Methods Handbook, CG 448-4)</small> Disperse and flush.		<b>2. LABELS</b> No hazard label required by Code of Federal Regulations.
<b>3. CHEMICAL DESIGNATIONS</b> 3.1 Synonyms: Water glass Soluble glass 3.2 Coast Guard Compatibility Classification: Not applicable 3.3 Chemical Formula: $\text{Na}_2\text{SiO}_3$ , $\text{Na}_2\text{SiO}_4$ , $\text{H}_2\text{O}$ 3.4 IMCO/United Nations Numerical Designation: Not listed		<b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 Physical State (as shipped): High viscous liquid 4.2 Color: Colorless 4.3 Odor: Odorless
<b>5. HEALTH HAZARDS</b> 5.1 Personal Protective Equipment: Goggles or face shield 5.2 Symptoms Following Exposure: If large doses are ingested, some irritation of mucous membranes may occur, similar to that caused by caustic soda solution. 5.3 Treatment for Exposure: INGESTION (large doses): give water or milk, do NOT induce vomiting. 5.4 Toxicity by Inhalation (Threshold Limit Value): Not pertinent 5.5 Short-Term Inhalation Limits: Not pertinent 5.6 Toxicity by Ingestion: Grade 2.0 (5 to 5 g/kg human) 5.7 Late Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Non-irritant 5.9 Liquid or Solid Irritant Characteristics: None 5.10 Odor Threshold: Not pertinent		
<b>6. FIRE HAZARDS</b> 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Not flammable 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not flammable		
<b>7. CHEMICAL REACTIVITY</b> 7.1 Reactivity with Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent		
<b>8. WATER POLLUTION</b> 8.1 Aquatic Toxicity: 2320 ppm/96 hr/mosquito fish/1 L/m <sup>3</sup> fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None		
<b>9. SELECTED MANUFACTURERS</b> 1. Diamond Shamrock Chemical Co. 1100 Superior Ave. Cleveland, Ohio 44114 2. E. I. duPont de Nemours & Co., Inc. Industrial and Biochemicals Dept. Wilmington, Del. 19895 3. Philadelphia Quartz Co. Public Ledger Bldg. Philadelphia, Pa. 19106		
<b>10. SHIPPING INFORMATION</b> 10.1 Grades or Purity: A wide variety of grades, which differ in concentration of sodium silicate in water, in specific gravity, and in viscosity. 10.2 Storage Temperature: Ambient 10.3 Inert Atmosphere: No requirement 10.4 Venting: Open		
<b>11. HAZARD ASSESSMENT CODE</b> <small>(See Hazard Assessment Handbook, CG 448-3)</small> A-P		<b>13. PHYSICAL AND CHEMICAL PROPERTIES</b> 13.1 Physical State at 15°C and 1 atm: Liquid 13.2 Molecular Weight: Not applicable 13.3 Boiling Point at 1 atm: Decomposes 13.4 Freezing Point: Not pertinent 13.5 Critical Temperature: Not pertinent 13.6 Critical Pressure: Not pertinent 13.7 Specific Gravity: 1.1-1.7 at 20°C (liquid) 13.8 Liquid Surface Tension: Not pertinent 13.9 Liquid-Water Interfacial Tension: Not pertinent 13.10 Vapor (Gas) Specific Gravity: Not pertinent 13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 13.12 Latent Heat of Vaporization: Not pertinent 13.13 Heat of Combustion: Not pertinent 13.14 Heat of Decomposition: Not pertinent 13.15 Heat of Solution: (solid) = 20 Btu/lb = 10 cal/g = $0.4 \times 10^3 \text{ J/kg}$ 13.16 Heat of Polymerization: Not pertinent
<b>12. HAZARD CLASSIFICATIONS</b> 12.1 Code of Federal Regulations: Not listed 12.2 MAS Hazard Rating for Bulk Water Transportation: Not listed 12.3 NFPA Hazard Classifications: Not listed		
NOTES		

## SULFUR

### SULFUR

#### General Information

Synonyms: brimstone; flowers of sulfur; sulfur flour.

Rhombic, yellow crystals or yellow powder.

Formula:  $S_8$ .

Mol wt: 256.48, mp: 119°C, bp: 444.6°C, flash p.: 405°F (C.C.), d: 2.07; d liquid: 1.803, autoign. temp.: 450°F, vap. press.: 1 mm at 183.8°C.

#### Hazard Analysis

Toxicity: Very low. See nuisance dusts. A fungicide. Chronic inhalation can cause irritation of mucous membranes.

Radiation Hazard: For permissible levels, see Section 5, Table 5. Artificial isotope  $^{35}S$ ,  $T_{1/2} = 88d$ . Decays to stable  $^{35}Cl$  via  $\beta$ 's of 0.17 MeV.

Fire Hazard: Slight, when exposed to heat or flame, or by chemical reaction with oxidizers.

Spontaneous Heating: No.

Explosion Hazard: Moderate, in the form of dust, when exposed to flame.

Disaster Hazard: Dangerous; when heated it burns and emits highly toxic fumes of  $SO_2$ ; can react with oxidizing materials.

#### Countermeasures

Personal Hygiene: Section 2.

To Fight Fire: Water or special mixtures of dry chemical (Section 7).

Storage and Handling: Section 7.

## VANADIUM PENTOXIDE

### VANADIUM PENTOXIDE \*

#### General Information

Yellow to red crystalline powder.

Formula:  $V_2O_5$ .

Mol wt: 181.90, mp: 690°C, bp: decomposes at 1750°C,  
d: 3.357 at 18°C.

#### Hazard Analysis

Toxicity: See vanadium compounds.

### VANADIUM COMPOUNDS \*

#### Hazard Analysis

Toxicity: Variable. Vanadium compounds act chiefly as irritants to the conjunctivae and respiratory tract. Prolonged exposures may lead to pulmonary involvement. There is still some controversy as to the effects of industrial exposure on other systems of the body. Responses are acute, never chronic.

The first report of vanadium poisoning in humans described rather widespread systemic effects, consisting of polycythemia, followed by red blood cell destruction and anemia, loss of appetite, pallor and emaciation, albuminuria and hematuria, gastrointestinal disorders, nervous complaints and cough, sometimes severe enough to cause hemoptysis. More recent reports describe symptoms which, for the most part, are restricted to the conjunctivae and respiratory system, no evidence being found of disturbances of the gastrointestinal tract, kidneys, blood or central nervous system. Though certain workers believe that it is only the pentoxide which is harmful, other investigators have found that patronite dust (chiefly vanadium sulfide) is quite toxic to animals, causing acute pulmonary edema. The fumes are highly toxic.

Symptoms and signs of poisoning are pallor, greenish-black discoloration of the tongue, paroxysmal cough, conjunctivitis, dyspnea and pain in the chest, bronchitis, rale and rhonchi, bronchospasm, tremor of the fingers and arms, radiographic reticulation. See also specific compounds.

These are common air contaminants.

#### Countermeasures

Ventilation Control: Section 2.

Personal Hygiene: Section 2.

VOX

## VANADIUM PENTOXIDE

Common Synonyms Vanadic anhydride Vanadium pentoxide		Solid	Yellowish-brown	Odorless
		Sinks in water.		
Avoid contact with solid and dust. Keep people away. Stop discharge if possible. Call the department. Isolate and remove discharged material. Notify local health and pollution control agency.				
<b>Fire</b>		Not flammable. Will increase the intensity of a fire. Floral discharge reacts with water.		
<b>Exposure</b>		<b>CAUTION MEDICAL AID:</b> <b>DUST:</b> Irritating to eyes, nose and throat. If inhaled will cause coughing or difficult breathing. If person's head explodes open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. <b>SOLID:</b> Irritating to skin and eyes. If swallowed will cause nausea. If person is contaminated, clothing and shoes. Flush affected areas with plenty of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS: have victim drink water or milk and have or have induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS: do nothing except keep victim warm.		
<b>Water Pollution</b>		<b>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.</b> May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		

<b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook, CG 448-4) Should be removed. Chemical and physical treatment.		<b>2. LABELS</b> No hazard label required by Code of Federal Regulations.	
<b>3. CHEMICAL DESIGNATIONS</b> 3.1 <b>Synonyms:</b> Vanadic anhydride, Vanadium pentoxide. 3.2 <b>Coast Guard Compatibility Classification:</b> Not listed. 3.3 <b>Chemical Formula:</b> V <sub>2</sub> O <sub>5</sub> . 3.4 <b>IMCO/United Nations Numerical Designation:</b> Not listed.		<b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 <b>Physical State (as shipped):</b> Solid. 4.2 <b>Color:</b> Yellow-orange (powder), dark gray (flakes), yellowish brown. 4.3 <b>Odor:</b> None.	

<b>5. HEALTH HAZARDS</b> 5.1 <b>Personal Protective Equipment:</b> Bu. Mines approved respirator; rubber gloves; goggles for prolonged exposure. 5.2 <b>Symptoms Following Exposure:</b> Inhalation of dust irritates nose and throat. Ingestion causes irritation of mouth and stomach. Contact with eyes or skin causes irritation; eczema may develop. 5.3 <b>Treatment for Exposure:</b> <b>INHALATION:</b> move to fresh air; if exposure to dust has been severe, get medical attention. <b>INGESTION:</b> induce vomiting; get medical attention. <b>EYES:</b> flush with water for at least 15 min. <b>SKIN:</b> flush with water; wash with soap and water. 5.4 <b>Toxicity by Inhalation (Threshold Limit Value):</b> 0.5 mg/m <sup>3</sup> . 5.5 <b>Short-Term Inhalation Limits:</b> Data not available. 5.6 <b>Toxicity by Ingestion:</b> Grade 1, oral LD <sub>50</sub> = 23 mg/kg (mouse). 5.7 <b>Late Toxicity:</b> Repeated exposures may cause discoloration of tongue, loss of appetite, anemia, kidney disorders, and blindness. 5.8 <b>Vapor (Gas) Irritant Characteristics:</b> Data not available. 5.9 <b>Liquid or Solid Irritant Characteristics:</b> Data not available. 5.10 <b>Odor Threshold:</b> Data not available.	
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<b>6. FIRE HAZARDS</b> 6.1 <b>Flash Point:</b> Not flammable. 6.2 <b>Flammable Limits in Air:</b> Not flammable. 6.3 <b>Fire Extinguishing Agents:</b> Not pertinent. 6.4 <b>Fire Extinguishing Agents Not to be Used:</b> Not pertinent. 6.5 <b>Special Hazards of Combustion Products:</b> Not pertinent. 6.6 <b>Behavior in Fire:</b> May increase intensity of fire when in contact with combustible materials. 6.7 <b>Ignition Temperature:</b> Not pertinent. 6.8 <b>Electrical Hazard:</b> Not pertinent. 6.9 <b>Burning Rate:</b> Not pertinent.	
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<b>7. CHEMICAL REACTIVITY</b> 7.1 <b>Reactivity with Water:</b> No reaction. 7.2 <b>Reactivity with Common Materials:</b> 7.3 <b>Stability During Transport:</b> Stable. 7.4 <b>Neutralizing Agents for Acids and Caustics:</b> Not pertinent. 7.5 <b>Polymerization:</b> Not pertinent. 7.6 <b>Inhibitor of Polymerization:</b> Not pertinent.	
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<b>8. WATER POLLUTION</b> 8.1 <b>Aquatic Toxicity:</b> 55 ppm/96 hr (fathead minnows/1 L tap/hard water); 11 ppm/96 hr (fathead minnows/1 L tap/soft water). 8.2 <b>Waterfowl Toxicity:</b> Data not available. 8.3 <b>Biological Oxygen Demand (BOD):</b> None. 8.4 <b>Food Chain Concentration Potential:</b> Data not available.	
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<b>9. SELECTED MANUFACTURERS</b> 1. Foote Mineral Co., Route 100, Exton, Pa. 19341. 2. Kerr-McGee Chemical Corp., Soda Springs, Idaho 83276. 3. Stauffer Chemical Co., Industrial Chemicals Div., Westport, Conn. 06880.	
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<b>10. SHIPPING INFORMATION</b> 10.1 <b>Grades or Purities:</b> Commercial, 98-99%. 10.2 <b>Storage Temperature:</b> Ambient. 10.3 <b>Inert Atmosphere:</b> No requirement. 10.4 <b>Venting:</b> Open.	
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<b>11. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook, CG 448-3) H	
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<b>12. HAZARD CLASSIFICATIONS</b> 12.1 <b>Code of Federal Regulations:</b> Not listed. 12.2 <b>NAB Hazard Rating for Bulk Water Transportation:</b> Not listed. 12.3 <b>MFPA Hazard Classifications:</b> Not listed.	
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<b>13. PHYSICAL AND CHEMICAL PROPERTIES</b> 13.1 <b>Physical State at 15°C and 1 atm:</b> Solid. 13.2 <b>Molecular Weight:</b> 181.88. 13.3 <b>Boiling Point at 1 atm:</b> Not pertinent (decomposes). 13.4 <b>Freezing Point:</b> Not pertinent. 13.5 <b>Critical Temperature:</b> Not pertinent. 13.6 <b>Critical Pressure:</b> Not pertinent. 13.7 <b>Specific Gravity:</b> 3.36 at 20°C (solid). 13.8 <b>Liquid Surface Tension:</b> Not pertinent. 13.9 <b>Liquid-Water Interfacial Tension:</b> Not pertinent. 13.10 <b>Vapor (Gas) Specific Gravity:</b> Not pertinent. 13.11 <b>Ratio of Specific Heats of Vapor (Gas):</b> Not pertinent. 13.12 <b>Latent Heat of Vaporization:</b> Not pertinent. 13.13 <b>Heat of Combustion:</b> Not pertinent. 13.14 <b>Heat of Decomposition:</b> Not pertinent. 13.15 <b>Heat of Solution:</b> Not pertinent. 13.16 <b>Heat of Polymerization:</b> Not pertinent.	
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(Continued on pages 5 and 6.)

NOTES

## ZINC OXIDE

### ZINC OXIDE \*

#### General Information

Synonyms: zincite; chinese white; zinc white; flowers of zinc.

White or yellowish powder.

Formula: ZnO.

Mol wt: 81.38, mp: > 1800°C, d: 5.47.

#### Hazard Analysis

Toxicity: A seed disinfectant. See zinc compounds. A fungicide. A trace mineral added to animal feeds. Also a dietary supplement food additive (Section 10).

### ZINC COMPOUNDS \*

#### Hazard Analysis

Toxicity: Variable, generally of low toxicity.

Toxicology: Zinc is not inherently a toxic element. However, when heated, it evolves a fume of zinc oxide which, when inhaled fresh, can cause a disease known as "brass founders' ague," or "brass chills." It is possible for people to become immune to it. However, this immunity can be broken by cessation of exposure of only a few days. Zinc oxide dust which is not freshly formed is virtually innocuous. There is no cumulative effect to the inhalation of zinc fumes. Fatalities, however have resulted from lung damage caused by the inhalation of high concentrations of zinc chloride fumes. Soluble salts of zinc have a harsh metallic taste; small doses can cause nausea and vomiting, while larger doses cause violent vomiting and purging. So far as can be determined, the continued administration of zinc salts in small doses has no effect in man except those of disordered digestion and constipation. Exposure to zinc chloride fumes can cause damage to the mucous membrane of the nasopharynx and respiratory tract and give rise to a pale gray cyanosis. Workers in zinc refining have been reported as suffering from a variety of non-specific intestinal, respiratory and nervous symptoms. Ulceration of the nasal septum and eczematous dermatosis are also reported.

It has been stated that zinc oxide dust can block the ducts of the sebaceous glands and give rise to a papular, pustular eczema in men engaged in packing this compound into barrels. Sensitivity to zinc oxide in man is extremely rare. Zinc chloride, because of its caustic action, can cause ulceration of the fingers, hands and forearms of those who use it as a flux in soldering. This condition has even been observed in men who handle railway ties which have been impregnated with this material. It is the opinion of some who work with it that it is carcinogenic.

A common air contaminant.

#### Countermeasures

Treatment and Antidotes: Personnel exposed to zinc chloride fumes should immediately wash the area of contact with copious quantities of warm water and soap. Remove all contaminated clothing at once and if the area of contact is large, subject patient to a deluge-type of shower as quickly as possible. If the eyes are involved in exposure to zinc chloride fumes, they should be irrigated for at least 15 minutes with warm water.

Ventilation Control: Section 2.

Personal Hygiene: Section 2.

Storage and Handling: Section 7.